Pharmacy Drug Guidelines Folder

For use in Adult Critical Care Areas and Adult Theatres only. Do not remove from Critical Care. Electronic copies are available in the guidelines folder on the intranet or NUH app.

Compiled by: Critical Care Pharmacists

Review Date: Jan 2020.
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<td>Critical Care Infusions Guide (Details also included in guideline footnote)</td>
<td>Aminophylline Loading dose now to be infused in 100ml only. Calcium Chloride removed and replace with Calcium Gluconate. Clonidine dose titrated to 3mcg/kg/hr in young patients Dopexamine removed –UK license withdrawn Esmolol max dose decreased to 300mcg/kg/min as per SPC Ketamine for spinal surgery amended as per new guidelines. Labetalol infusion includes line specifically for peripheral administration. Removed Glucose preferred as glucose 5% 500ml bags not stocked within critical care. Rate of Labetalol increased to a standard of 0-200mg/hr – as A-Z drugs in intensive care/ Up to date / Micromedex/ SPC Metaraminol concentration for infusion changed Omeprazole infusion. Loading dose given in 250ml over an hour as per the Blue IV guide. Pabrinex volume for infusion changed to 100ml only. Propofol max rate changed to 4mg/kg/hr Sodium Chloride 2.7% volume of polyfusor changed to 500ml. Tranexamic Acid details added. Volumes and infusion times of vancomycin amended to match DERS programme on pumps. Remifentanyl added. Absolute alcohol intranet link updated and recommendation for fomepizole treatment first line added. Argatroban added and danaparoid deleted. New agent for the management of heparin induced thrombocytopenia. Digoxin removed the need for doctor in attendance for the first dose. Flumazenil concentration for infusion and rate of infusion changed as per 2015 trust-wide guideline. Glucagon updated bolus dose and infusion rate as per EDIS guideline 2015. Immunoglobulin updated choice of immunoglobulin to Privigen. Updated ketamine to a maximum of 2mg/ml for peripheral administration as per spinal prescription concentrations. Added details of prescription.</td>
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NUH list of critical drugs which should not be omitted or delayed

To make sure that drugs are most effective and to prevent patients from suffering harm, it is important for some drugs to be administered at specific times.

The following list of drugs are considered critical and must never be omitted or delayed without a clinical reason which has been discussed with the medical team.

The reason for the omission and a plan of action must be documented on the Medication Management Plan found on the back pages of the Prescription Chart. If you are unfamiliar with a drug name, you must check to find out what it is prior to prescribing, ordering or administering the drug.

This list is not exhaustive. There will be other medicines that are only used in specialist areas where timeliness of administration is also crucial. Also refer to the local list in use in your specialist area where one exists.

- **ALL medicines used in emergency situations**
  FOR EXAMPLE: resuscitation and anaphylaxis drugs, reversal agents /antidotes, glucagon, oxygen, salbutamol, inotropes, fluids
- **Anti-coagulants** - prophylaxis and treatment
  (enoxaparin, heparin, warfarin, rivaroxaban, apixaban, dabigatran, phenindione nicooumalone (acenocoumarol))
- **Anti-epileptics**
- **Anti-infectives**
  (Antibiotics, Antivirals, Antifungals, Antiretrovirals, Antimalarials, MRSA decolonisation)
- **Anti-Parkinson medicines**
- **Insulin**
- **Steroids (oral and parenteral)**
- **Strong opioids prescribed regularly for acute or chronic pain.**

Of course all other drugs should also be given as close as possible to the prescribed time & must be administered within half the dosing interval e.g. prescribed 6 hourly, must be given within 3 hours of the prescribed time, prescribed daily, must be given within 12 hours of the prescribed time.

**Obtaining supplies of critical medicines**
Critical medicines are held as stock on wards that regularly use these medicines. The flow diagram overleaf shows how to obtain supplies if the medicine is unavailable on your ward.

**Reporting omission of critical medicines**
The omission or delay of critical medicines is a patient safety incident and must be recorded on DATIX.

For further information please see the [NPSA alert RRR009](http://www.npsa.nhs.uk/alerts/RRR009) and the NUH Medicines Policy chapters on Prescribing, Administration and Supply of Medicines from Pharmacy.
Flow chart for obtaining Critical Drugs at NUH

WARD STAFF- Is the critical medicine available on the ward?

CHECK: Have Pharmacy signed the chart to indicate a supply has been made or that the item is held as stock on the ward?
Have all Pharmacy Envopaks been unpacked?
Has the patient recently changed wards?
Have non-stock medicines been transferred with the patient from the previous ward?

Yes → Correctly administer and document all doses given

No → Has the patient brought in their own medicines?

CHECK: Has the patient recently changed wards? If the patient has recently been transferred, their own medicines may still be on the previous ward.

No → Is the Pharmacy open?

CHECK: Look on the Pharmacy homepage on the intranet for opening times

No → Bleep the on call pharmacist via switchboard and request an urgent supply.

Yes → Bleep your ward pharmacist and request an urgent supply.

CHECK: Look on the Pharmacy homepage on the intranet for details of the Pharmacist rotas and the name & bleep number of the person providing the clinical pharmacy service to your ward today

ONCALL PHARMACIST

Is the medicine available in the Emergency Drug Cupboard

Yes → Direct ward staff to obtain a supply from the Emergency Drug Cupboard

No → Is the medicine available from other wards on the same campus

No → Make an urgent supply from Pharmacy. Contact the ward immediately when the drug is ready.

Yes → Direct ward staff to obtain a supply from a stockholding ward on the same campus
Drug Labelling Requirements & infusion expiries in Adult Critical Care Areas

Labels are used in critical care areas to improve the safety and accuracy of Intravenous (IV) drug administration. Patients within critical care settings may have several lines in use at any one time and the use of labels is an additional visual aid to identify what is being administered. They must NOT however replace ‘best’ practice of tracking back from the patient’s infusion pumps to the individual infusion lines to confirm the infusion running or prior to recommencing an interrupted infusion.

General Requirements
All intravenous drug infusions and lines within adult critical care must adhere to the following general requirements:

- All IV infusions MUST be labelled in accordance with the standards in the NUH Medicines Policy: Code of Practice.
- Drug line labels are to be wrapped around the infusion line at the distal (patient) end of the line.
- If a pre-printed drug line label does not exist a handwritten one must be written using the additional sticker at the bottom of the IV additive label. The NUH Sticker catalogue provides details of all drug stickers available.
- Provided IV lines are not disconnected from the patient they can remain in situ for a maximum of 72 hours – with the exception of Propofol & TPN lines which must be changed every 24 hours.
- Drug infusions prepared in a ward area must be disposed of at 24 hours or sooner if directed by the NUH IV guide or critical care drug standard infusions table.
- IV drug infusions that have been interrupted/stopped but remain connected to the patient must be clamped off. They may remain in situ until their expiry – with the explicit exceptions detailed below.
- A two-person check must occur on all IV infusions following the standards in the NUH Medicine Policy: Code of Practice. This includes prior to commencement, for all rate changes and prior to restarting an interrupted infusion.

Vasoactive agents and concentrated potassium infusions.
Due to the high-risk nature of these drugs the following additional requirements apply:

Vasoactive Agents: (noradrenaline, adrenaline, dobutamine and vasopressin).
- MUST have the infusion lines clamped if stopped or interrupted.
- If stopped for 4 hours (or sooner if the expiry of the infusion is reached) the vasoactive infusion must be disconnected and disposed of.
- Three-way taps are not used routinely for vasopressors on level 2 patients but should be considered for use in level 3 who are unstable and likely to require a number of infusions.
**Noradrenaline Infusions**

- Each noradrenaline infusion line must have **Noradrenaline** purple coloured labels attached as follows:
  1. One large label (as picture below) on the infusion bag.
  2. Two large labels sandwiched together on the IV line directly above the pump.
  3. One small double-sided label on the IV line right next to the connection on to the patient’s CVC.
  4. Additionally a double-sided orange Do not bolus sticker must also be placed directly above the pump. **DO NOT BOLUS** stickers are also intended to be used on Neat Potassium, phosphate and insulin infusions.

![Noradrenaline Label](image)

**Concentrated Potassium Infusions**

- Premade syringes for potassium chloride (50mmol/50mls) that have only been partly infused and interrupted must be clamped and discarded after **4 hours**.
- Further information about when to interrupt a potassium infusion is detailed in the policy for potassium replacement in critical care.
- If a neat potassium dihydrogen (acid) phosphate is interrupted for any reason after a period of **4 hours** this must also be discarded.

**Small volume infusion flushes**

The giving sets used for the volumetric pumps have a ‘dead space’ within them of approximately 23ml. For a small number of critical drugs this can result in a significant proportion of the drug being lost in the giving set. It has been agreed by the local critical care governance committee that for phenytoin and IV antibiotics diluted in 50-100ml that post administration (unless the giving set is to remain connected for the next dose) a small volume infusion bag of the same fluid (e.g. 50 or 100ml sodium chloride 0.9%) should be connected to the giving set on completion of the infusion and the pump programmed to deliver 23ml to **FLUSH** the set. At present **NO IV** flush is prescribed and so this flush would be second checked in the same way as all other flushes. The total volume administered to the patient is just recorded as the total volume of the infusion not an additional 23ml. This is because it just administers to the patient the intended dose.
<table>
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<tr>
<th>Title of Guideline</th>
<th>Administration Guide for Commonly Used Intravenous Therapy within Adult Critical Care</th>
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<tr>
<td>Contact Name and Job Title (author)</td>
<td>Eleanor Mills – Specialist Critical Care Pharmacist</td>
</tr>
<tr>
<td></td>
<td>Matthew Brooks – Critical Care Pharmacist</td>
</tr>
<tr>
<td>Directorate &amp; Speciality</td>
<td>Clinical Support</td>
</tr>
<tr>
<td>Date of last review</td>
<td>January 2017 (first version 2016; adapted from 7.1 Edition NUH Administration Guide Intravenous Therapy in Adults)</td>
</tr>
<tr>
<td>Date on which guideline must be reviewed</td>
<td>January 2019</td>
</tr>
<tr>
<td>Explicit definition of patient group to which it applies (e.g. inclusion and exclusion criteria, diagnosis)</td>
<td>Applies to all adult patients managed with adult critical care.</td>
</tr>
<tr>
<td>Abstract</td>
<td>This document is intended to support the safe and timely intravenous administration of commonly used drugs within adult critical care. If drugs are not found within this table, please refer to the intranet version of the NUH Administration Guide Intravenous Therapy in Adults (Blue Pages) whilst still available, at:</td>
</tr>
<tr>
<td></td>
<td>Otherwise, the national IV Medusa pages, once it has been implemented at NUH</td>
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<tr>
<td>Consultation Process</td>
<td>Critical care pharmacists at NUH and Critical Care Governance Committee.</td>
</tr>
<tr>
<td>Target audience</td>
<td>Medical, nursing staff and pharmacists working within critical care.</td>
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<tr>
<td>Drug</td>
<td>Direct Inj</td>
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<td>-----------------</td>
<td>------------</td>
</tr>
<tr>
<td>Aciclovir</td>
<td>x</td>
</tr>
<tr>
<td>Amoxicillin</td>
<td>✓</td>
</tr>
<tr>
<td>Anidulafungin</td>
<td>x</td>
</tr>
<tr>
<td>Anidulafungin</td>
<td></td>
</tr>
<tr>
<td>Benzylpenicillin</td>
<td>✓</td>
</tr>
<tr>
<td>Drug</td>
<td>Direct Inj</td>
</tr>
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<td>-------------------</td>
<td>------------</td>
</tr>
<tr>
<td>Ceftriaxone</td>
<td>✓</td>
</tr>
<tr>
<td>Cefuroxime</td>
<td>✓</td>
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<tr>
<td>Ciprofloxacin</td>
<td>×</td>
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<tr>
<td>Clarithromycin</td>
<td>×</td>
</tr>
<tr>
<td>Clindamycin</td>
<td>×</td>
</tr>
<tr>
<td>Co-amoxiclav</td>
<td>✓</td>
</tr>
</tbody>
</table>

**Note:**

- CEPHALOSPORIN
- This is a PENICILLIN-check allergy status of patient before administration
- **✓** indicates direct injection is preferred
- **×** indicates direct injection is not preferred
- **G** = Glucose 5%
- **S** = Sodium Chloride 0.9%
<table>
<thead>
<tr>
<th>Drug</th>
<th>Direct Inj</th>
<th>Diluent</th>
<th>Method of administration using a side arm of a giving set or into indwelling cannula without further dilution</th>
<th>Compatable Fluid</th>
<th>Method of administration by addition to infusion container</th>
<th>Additional Information</th>
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<tr>
<td>Co-trimoxazole (Septrin®)</td>
<td>×</td>
<td>G, S</td>
<td>Dilute each 5mL ampoule with 125mL of G or S e.g. 1x5mL ampoule to 125mL, 2x5mL ampoule to 250mL, 3x5mL ampoule to 500mL. Infuse over 60-90 minutes using a volumetric pump.</td>
<td>G, S</td>
<td>Preferably administer via a large peripheral vein (or central venous catheter) to avoid potential venous irritation as the preparation has a high pH. For fluid restricted patients a 5mL (480mg) ampoule can be diluted with 75mL G ONLY (usually rounding to nearest infusion bag size) and the total infusion given over 60 minutes. Note, 500mL G not stocked on NUH Critical Care areas – order from pharmacy. Co-trimoxazole occasionally may be infused as an unlicensed method of infusion neat via a CENTRAL VENOUS CATHETER only over 90-120 minutes. Contact pharmacy for further advice.</td>
<td></td>
</tr>
<tr>
<td>Digoxin</td>
<td>×</td>
<td>G, S, GS</td>
<td>Further dilute dose in 50-100mL infusion fluid and infuse over 1-2 hours. In urgent cases can be given over 10-20 minutes; monitor for signs of digoxin toxicity.</td>
<td>G, S</td>
<td>ECG monitoring required if loading dose or newly started.</td>
<td></td>
</tr>
<tr>
<td>Erythromycin</td>
<td>×</td>
<td>S</td>
<td>Further dilute doses up to 250mg in 50mL S, doses 251-500mg in 100mL S, doses 501-1000mg in 250mL S. Infuse over 20-60 minutes.</td>
<td>S</td>
<td>Maximum concentration 5mg per mL</td>
<td></td>
</tr>
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</table>

**Drug Administration Options:**

- **Co-trimoxazole (Septrin®):**
  - Already in solution 480mg in 5mL (Each 5mL ampoule contains trimethoprim 80mg and sulfamethoxazole 400mg)
  - Dilute each 5mL ampoule with 125mL of G or S e.g. 1x5mL ampoule to 125mL, 2x5mL ampoule to 250mL, 3x5mL ampoule to 500mL. Infuse over 60-90 minutes using a volumetric pump.

- **Digoxin:**
  - Already in solution 500microgram in 2mL ampoule
  - Further dilute dose in 50-100mL infusion fluid and infuse over 1-2 hours. In urgent cases can be given over 10-20 minutes; monitor for signs of digoxin toxicity.

- **Erythromycin:**
  - Add 20mL WFI to 1g vial.
  - Further dilute doses up to 250mg in 50mL S, doses 251-500mg in 100mL S, doses 501-1000mg in 250mL S. Infuse over 20-60 minutes.

**Notes:**

- Preferably administer via a large peripheral vein (or central venous catheter) to avoid potential venous irritation as the preparation has a high pH.
- For fluid restricted patients a 5mL (480mg) ampoule can be diluted with 75mL G ONLY (usually rounding to nearest infusion bag size) and the total infusion given over 60 minutes. Note, 500mL G not stocked on NUH Critical Care areas – order from pharmacy.
- Co-trimoxazole occasionally may be infused as an unlicensed method of infusion neat via a CENTRAL VENOUS CATHETER only over 90-120 minutes. Contact pharmacy for further advice.

**ECG Monitoring:**

- ECG monitoring required if loading dose or newly started.
<table>
<thead>
<tr>
<th>Drug</th>
<th>Direct Inj</th>
<th>Diluent</th>
<th>Method of administration using a side arm of a giving set or into indwelling cannula without further dilution</th>
<th>Compatibl e Fluid</th>
<th>Method of administration by addition to infusion container (Doctor does not need to be in attendance unless stated. Nurse can administer by infusion if instruction in this column)</th>
<th>Additional Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flucloxacillin</td>
<td>✓</td>
<td>Add 5-10mL WFI to 250mg and 500mg vial. Add 15-20mL WFI to 1g vial.</td>
<td>For doses up to 1g: Inject over 3-4 minutes For 2g doses: Inject over 6-8 minutes.</td>
<td>S, G (S preferred)</td>
<td>If required doses of 2g can be added to 100ml of infusion fluid and infused over 30-60 minutes.</td>
<td>This is a PENICILLIN-check allergy status of patient before administration</td>
</tr>
<tr>
<td>Fluconazole</td>
<td>×</td>
<td>Already in solution 50mg in 25mL and 200mg in 100mL</td>
<td>S flush</td>
<td></td>
<td>Further dilution is unnecessary.</td>
<td></td>
</tr>
<tr>
<td>Haloperidol</td>
<td>✓</td>
<td>Already in solution. 5mg in 1mL ampoules.</td>
<td>Inject over 1-2 minutes. May be further diluted to a convenient volume.</td>
<td>S</td>
<td>IV haloperidol is an UNLICENSED method of administration. It may only be given within critical care with continuous ECG monitoring recommended. See critical care local agreement for IV administration. Note, oral dose is NOT equivalent to IV dose.</td>
<td></td>
</tr>
<tr>
<td>Levetiracetam</td>
<td>×</td>
<td>Already in solution 500mg in 5mL. Further dilute for infusion.</td>
<td>G, S, GS</td>
<td></td>
<td>Preferably administer via a large peripheral vein (or central venous catheter) to avoid potential venous irritation as the preparation has a low pH.</td>
<td></td>
</tr>
<tr>
<td>Levofloxacin</td>
<td>×</td>
<td>Already in solution. 250mg in 50mL and 500mg in 100mL.</td>
<td>G, S, GS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drug</td>
<td>Direct Inj</td>
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<tr>
<td>Linezolid</td>
<td>×</td>
<td>Already in solution 600mg in 300mL infusion bag.</td>
<td></td>
<td>Flush with S,</td>
<td>Infuse over 30-120 minutes</td>
<td></td>
</tr>
<tr>
<td>Meropenem CARBAPENEM not to be given if severe penicillin allergy</td>
<td>✓</td>
<td>Add 10mL WFI to 500mg vial Add 20mL WFI to 1g vial</td>
<td>Doses up to 1g: Inject over 5 minutes</td>
<td>G, S</td>
<td>For doses over 1g: Further dilute in 100ml and infuse over 15-30 minutes</td>
<td>2g doses should be administered by infusion.</td>
</tr>
<tr>
<td>Methylprednisolone (as sodium succinate Solu-Medrone®)</td>
<td>✓</td>
<td>Vials of 40mg, 125mg, 500mg, 1g &amp; 2g. Diluent provided.</td>
<td>For doses up to 250mg: Inject over 5 minutes</td>
<td>G, S, GS</td>
<td>Give by infusion for doses over 250mg. Generally infused over at least 30 minutes, although a wide range of rates possible. Often 1g in 100mL over 1 hour.</td>
<td></td>
</tr>
<tr>
<td>Metoclopramide</td>
<td>✓</td>
<td>Already in solution 10mg in 2mL</td>
<td>Inject 10mg in 2mL preparation over at least 3 minutes</td>
<td>G, S, GS, H</td>
<td>Infuse at a maximum rate of 5mL per minute (25mg per minute) which is 500mg in 100mL over a minimum of 20 minutes</td>
<td></td>
</tr>
<tr>
<td>Metronidazole</td>
<td>×</td>
<td>Already in solution 500mg in 100mL</td>
<td></td>
<td>S</td>
<td>Further dilute 40mg to 100mL or 80mg to 100mL and infuse over 20 to 30 mins. Post endoscopy protocol requires further dilution of 80mg in 100mL or 250mL S for infusion over 1 hour followed by continuous infusion of 80mg in 250mL S at a rate of 8mg/hour (25mL/hr) for 72 hours.</td>
<td></td>
</tr>
<tr>
<td>Omeprazole</td>
<td>×</td>
<td>Add 5mL Sodium Chloride 0.9% or Glucose 5% to 40mg vial for infusion</td>
<td>Note: A preparation for injection exists, not stocked at NUH</td>
<td>S preferred, stable for 12 hours. G stable for 6 hours (Teva &amp; Bowmed brands).</td>
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</tr>
<tr>
<td>Drug</td>
<td>Direct Inj</td>
<td>Diluent</td>
<td>Method of administration using a side arm of a giving set or into indwelling cannula without further dilution</td>
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<tr>
<td>Ondansetron</td>
<td>✓</td>
<td>Already in solution 4mg in 2mL and 8mg in 4mL ampoules</td>
<td>Inject over 3 - 5 minutes</td>
<td>G, S</td>
<td>Dilute in 50-100mL of infusion fluid and infuse over 15 minutes</td>
<td>In patients aged 65 years or older, all intravenous doses for prevention of Chemotherapy Induced Nausea and Vomiting should be diluted in 50–100 mL saline or other compatible fluid and infused over at least 15 minutes.</td>
</tr>
<tr>
<td>Pabrinex® (Vitamins B and C)</td>
<td>×</td>
<td>Already in solution. Ampoule 1 (5mL) contains thiamine, riboflavin, pyridoxine. Ampoule 2 (5mL) contains ascorbic acid, nicotinamide, glucose. Further dilute for infusion.</td>
<td>Draw up the contents of ampoule 1 and ampoule 2 (one pair) into the same syringe. Mix, then add to 50-100mL infusion fluid and infuse over 30 minutes. Up to three pairs may be added to one 100mL bag.</td>
<td>S, G</td>
<td>Note: Hypersensitivity reactions may occur. Facilities for treating anaphylaxis to be available when Pabrinex® is given (Adrenaline and chlorphenamine should be available).</td>
<td></td>
</tr>
<tr>
<td>Paracetamol</td>
<td>×</td>
<td>Already in solution 10mg per 1mL as 50mL or 100mL vials.</td>
<td></td>
<td>G, S</td>
<td>Infuse over 15 minutes</td>
<td>The dose of intravenous paracetamol should be reduced in patients weighing less than 50kg (maximum 60mg/kg/day) usually 1g TDS</td>
</tr>
<tr>
<td>Drug</td>
<td>Direct Inj</td>
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<tr>
<td>Phenytoin LOADING DOSE</td>
<td>×</td>
<td>Already in solution 250mg in 5mL ampoule</td>
<td><strong>Undiluted method:</strong> Infuse undiluted into a central vein or large peripheral vein using a syringe pump. Maximum rate 50mg per minute. <strong>NO filter needed.</strong></td>
<td>S ONLY</td>
<td><strong>Diluted method:</strong> Add doses of 1g or less to 100mL S. Add doses of greater than 1g to 250mL S. Administer by selecting PHENYTOIN LOAD on the dose error reduction software (DERS) on the volumetric pump. <strong>MUST use a giving set containing a 0.2 micron in line filter</strong> (Carefusion 60033E). Administration must commence immediately after the mixture has been prepared and must be completed within one hour. Maximum rate 50mg per minute.</td>
<td>• The maximum administration rate in adults is 50 mg per minute. • If diluted, use only sodium chloride 0.9% to a maximum phenytoin concentration of 10mg per mL. <strong>Continuous ECG and blood pressure monitoring is essential during infusion</strong> Flush the line with saline before and after administration to avoid local venous irritation as phenytoin has a high pH. • Do not allow to come into contact with any other drugs or solution infusions. Phenytoin injection is also susceptible to dangerous precipitation if diluted or mixed with other medicines (reducing the effective dose administered). • If the patient experiences hypotension or bradycardia consider slowing the infusion rate.</td>
</tr>
<tr>
<td>Phenytoin MAINTENANCE DOSE</td>
<td>✓</td>
<td>Already in solution 250mg in 5mL ampoule</td>
<td><strong>Undiluted method:</strong> Infuse undiluted into a central vein or large peripheral vein using a syringe pump. Maximum rate 50mg per minute. Suggested rate is 30mg per minute e.g. 300mg once daily given over 10 minutes. <strong>NO filter needed.</strong></td>
<td>S ONLY</td>
<td><strong>Diluted method:</strong> Add dose of 100mg to 50mL S. Add dose of 300mg to 50mL or 100mL S Administer by selecting PHENYTOIN MAINT on the dose error reduction software (DERS) on the volumetric pump. MUST use a giving set containing a 0.2 micron in line filter (Carefusion 60033E). Administration must commence immediately after the mixture has been prepared and must be completed within one hour. Maximum rate 50mg per minute.</td>
<td>• If the patient experiences hypotension or bradycardia consider slowing the infusion rate.</td>
</tr>
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<tr>
<td>Phytomenadione (Vitamin K, Konakion® MM)</td>
<td>✓</td>
<td>Already in solution 10mg in 1mL ampoules</td>
<td>Inject over at least 30 seconds</td>
<td>G ONLY for dilution. S can be used for flush.</td>
<td>Can be further diluted with 50mL G and infused over 20-30 minutes.</td>
<td>Protect diluted product from light.</td>
</tr>
<tr>
<td>Piperacillin with tazobactam (Tazocin®)</td>
<td>✓</td>
<td>Add 20mL WFI or S to 4.5g vial</td>
<td>Inject over 5 minutes (unlicensed)</td>
<td>G, S, GS</td>
<td>May be further diluted to 50-150mL and infused over 20-30 minutes. Not routine practice at NUH.</td>
<td></td>
</tr>
<tr>
<td>Ranitidine</td>
<td>✓</td>
<td>Already in solution 50mg in 2mL ampoules</td>
<td>Inject over at least 2-5 minutes</td>
<td>G, S, GS,</td>
<td>IV infusion maximum 25mg per hour. Add 50mg to 100mL of compatible infusion fluid.</td>
<td></td>
</tr>
<tr>
<td>Rifampicin</td>
<td>×</td>
<td>Add 5mL of diluent provided to each 300mg vial or 10mL to 600mg vial. Shake vigorously for 30 seconds. Further dilute for infusion.</td>
<td></td>
<td>G, S,</td>
<td>Dilute to 500mL to a final concentration of 1-2mg per mL. Infuse over 2-3 hours. Infusion must be completed within 3 hours of preparation as rifampicin may degrade and precipitate after this time.</td>
<td>Administer via a large peripheral vein (or central venous catheter). In fluid restricted patients can add to 100mL S or G and infuse over 30 minutes.</td>
</tr>
<tr>
<td>Drug</td>
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<tr>
<td>Sodium Bicarbonate</td>
<td>✓</td>
<td>Already in solution. 1.26%, 1.4%, 4.2% and 8.4% solution.</td>
<td>Only by direct injection from prefilled syringe in cardiac arrest and at request of ALS trained practitioner. Over at least 2-3 minutes</td>
<td>S</td>
<td>Infusion from Polyfusor with volumetric pump.</td>
<td>Concentrations exceeding 1.4% should always be given via a central line. Note: great care needed not to infuse more than prescribed volume.</td>
</tr>
<tr>
<td>Sodium Valproate</td>
<td>✓</td>
<td>Wockhardt brand: Already in solution 400mg in 4mL Epilim® Brand: Add 3.8mL of diluent provided (WFI) to each 400mg vial. Resultant solution is 100mg in 1mL.</td>
<td>For doses up to 600mg Inject over 3-5 minutes for doses above 600mg give as an infusion over 60 minutes diluted in at least 50ml of compatible diluent.</td>
<td>G, S</td>
<td>Infuse using a syringe pump or volumetric pump Do not exceed a rate of 20mg/minute</td>
<td>Do not infuse Sodium Valproate solutions with any other medicines or infusion fluids. Dr should be available if given for status epilepticus.</td>
</tr>
<tr>
<td>Terlipressin</td>
<td>✓</td>
<td>Already in solution: 1mg in 8.5mL (amp) or 1mg in 5ml (vial)</td>
<td>Over 3-5 minutes, preferably via a peripheral vein.</td>
<td></td>
<td></td>
<td>Stored in the refrigerator</td>
</tr>
<tr>
<td>Drug</td>
<td>Direct Inj</td>
<td>Diluent</td>
<td>Method of administration</td>
<td>Compatibl e Fluid</td>
<td>Method of administration by addition to infusion container</td>
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<tr>
<td>Tranexamic Acid</td>
<td>✓</td>
<td>Already in solution 500mg in 5mL ampoule</td>
<td>Do not exceed a rate of 100mg per minute</td>
<td>G, S</td>
<td>Can be further diluted for continuous infusion for prolonged therapy via volumetric pump or syringe pump.</td>
<td></td>
</tr>
<tr>
<td>Vancomycin</td>
<td>×</td>
<td>Add 10mL WFI to each 500mg vial. Add 20mL WFI to each 1g vial. Further dilute for infusion.</td>
<td>G, S</td>
<td>Standard concentration is 5mg per mL. Dilute 500mg in 100mL, 750mg-1.25g in 250mL and 1.5g-2g in 500mL. Infuse at a rate not exceeding 10mg per minute using a volumetric pump 500mg over at least 50 mins 750mg over at least 75 mins 1g over at least 100 mins 1.25g over at least 125 mins 1.5g over at least 150 mins 2g over at least 200 mins.</td>
<td>NOTE: Levels should be monitored. In fluid restricted patients can be diluted to a concentration of 10mg/mL and infused via a CENTRAL VENOUS CATHETER. Dilute 500mg in 50mL, 750mg-1g in 100mL, 1.25g-2g in 250mL.</td>
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<tr>
<td>Title of Guideline</td>
<td>Guide to Adult Critical Care Standard Intravenous Infusions</td>
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<tr>
<td>Contact Name and Job Title (author)</td>
<td>Elizabeth Jamieson Advanced Practitioner Pharmacist - Critical Care</td>
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<td>Directorate &amp; Speciality</td>
<td>Specialist Support</td>
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<tr>
<td>Date of last review</td>
<td>October 2015 (first version 2004) rechecked for accuracy September 2016</td>
<td></td>
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<tr>
<td>Date on which guideline must be reviewed</td>
<td>August 2018</td>
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<tr>
<td>Explicit definition of patient group to which it applies (e.g. inclusion and exclusion criteria, diagnosis)</td>
<td>Applies to all adult patients managed with adult critical care, high dependency units, trauma ward (level 1) and adult theatres</td>
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<tr>
<td>Abstract</td>
<td>This guideline describes the standard drugs used within adult critical care in terms of: their recommended dose ranges, concentrations, routes and rates of administration. Many of the doses and infusion concentrations used are unlicensed. It is intended for use in conjunction with the current Nottingham University Hospitals Guide to IV therapy and the NUH Medicines Code of Practice.</td>
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<tr>
<td>Evidence base of the guideline: Evidence base: (1-5)</td>
<td>3 well-designed non experimental descriptive studies (i.e. comparative/correlation and case studies) 4 expert committee reports or opinions and / or clinical experiences of respected authorities 5 recommended best practise based on the clinical experience of the guideline developer</td>
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<tr>
<td>Consultation Process</td>
<td>Critical care pharmacists at NUH – October 2015 edition checked by James Parker Critical Care Governance Committee</td>
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<tr>
<td>Target audience</td>
<td>Medical, nursing staff and pharmacists working within critical care and theatres</td>
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</tbody>
</table>

This guideline has been registered with the trust. However, clinical guidelines are guidelines only. The interpretation and application of clinical guidelines will remain the responsibility of the individual clinician. If in doubt contact a senior colleague or expert. Caution is advised when using guidelines after the review date.
<table>
<thead>
<tr>
<th>Drug</th>
<th>Infusion concentration</th>
<th>Compatible Infusion fluid</th>
<th>Route</th>
<th>Usual Dosage Range</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Abelcet</strong>&lt;br&gt;(Amphotericin B lipid complex)**&lt;br&gt;<em>City use only</em>&lt;br&gt;&lt;br&gt;<em>Critical Care Guideline available</em></td>
<td>1-2mg/ml</td>
<td><strong>G</strong>&lt;br&gt;&lt;br&gt;C / P</td>
<td><strong>1-5mg/kg once daily</strong>&lt;br&gt;&lt;br&gt;Infuse at a rate not exceeding 2.5mg/kg/hour</td>
<td>A <strong>1mg test dose</strong> must be given over 15 minutes. Available as 100mg vials consider rounding to nearest 100mg as appropriate. <strong>Flush before and after admin with G only. Incompatible with S.</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Absolute Alcohol</strong>&lt;br&gt;(100% Ethanol)**&lt;br&gt;<em>Drug stocked in ED on QMC Campus and Main Pharmacy at City Campus</em></td>
<td>Solutions of 100% Ethanol must be diluted to give a 10% solution for IV infusion.&lt;br&gt;&lt;br&gt;Refer to dose range column&lt;br&gt;&lt;br&gt;Refer to dose range column&lt;br&gt;&lt;br&gt;Refer to dose range column&lt;br&gt;&lt;br&gt;(G preferred)</td>
<td><strong>G, S</strong>&lt;br&gt;&lt;br&gt;C preferred&lt;br&gt;&lt;br&gt;Or large peripheral vein</td>
<td><strong>150mg/kg in 250ml over 60 mins, then 50mg/kg in 250ml over 4 hours, then 150mg/kg in 1000ml infused over 24 hours, Repeat this bag for up to 72 hours</strong>&lt;br&gt;&lt;br&gt;Due to the volume of acetylcysteine to added to the first bag. Remove 50ml prior to adding the drug for this bag ONLY.&lt;br&gt;&lt;br&gt;If FLUID RESTRICTED the 24 hour bag can be diluted in 250ml&lt;br&gt;&lt;br&gt;&lt;strong&gt;Discontinue any prescriptions for Paracetamol&lt;/strong&gt;</td>
<td>Trust Guideline for Ethylene Glycol Poisoning see Emergency department (ED) intranet page <a href="http://nuhnet/acute_medicine/edis_protocols/Adult%20Protocols/Forms/AllItems.aspx">http://nuhnet/acute_medicine/edis_protocols/Adult%20Protocols/Forms/AllItems.aspx</a></td>
<td></td>
</tr>
<tr>
<td><strong>Acetylcysteine</strong>&lt;br&gt;(Acute liver failure)**&lt;br&gt;&lt;br&gt;<em>See Guideline below for Paracetamol Overdose</em></td>
<td>Refer to dose range column</td>
<td><strong>G, S</strong>&lt;br&gt;&lt;br&gt;(G preferred)</td>
<td><strong>C / P</strong></td>
<td>For patients &gt;110kg the dose should be based on 110kg</td>
<td>For the 4 hour bag use 500ml sodium chloride 0.9% as 500ml glucose 5% not stocked in critical care&lt;br&gt;&lt;br&gt;&lt;strong&gt;Prescribing sticker available&lt;/strong&gt;</td>
</tr>
<tr>
<td><strong>Acetylcysteine</strong>&lt;br&gt;(Paracetamol Overdose)**&lt;br&gt;&lt;br&gt;<em>Trust wide guideline</em> <a href="http://nuhnet/nuh_documents/Guidelines/Trust%20Wide/Trust%20Wide/2194.pdf">http://nuhnet/nuh_documents/Guidelines/Trust%20Wide/Trust%20Wide/2194.pdf</a></td>
<td><strong>G, S</strong>&lt;br&gt;&lt;br&gt;(G preferred)</td>
<td><strong>C / P</strong></td>
<td>Dose as guideline&lt;br&gt;&lt;br&gt;For patients &gt;110kg the dose should be based on 110kg</td>
<td>For the 4 hour bag use 500ml sodium chloride 0.9% as 500ml glucose 5% not stocked in critical care&lt;br&gt;&lt;br&gt;&lt;strong&gt;Prescribing sticker available&lt;/strong&gt;</td>
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<tr>
<td><strong>Acetylcysteine</strong>&lt;br&gt;(Renal protection prior to contrast media)**&lt;br&gt;&lt;br&gt;<em>Critical Care guideline</em></td>
<td><strong>S</strong></td>
<td><strong>C / P</strong></td>
<td><strong>Details on sticker</strong></td>
<td>Prescribe on the stat section of the drug chart using the pre-printed sticker.</td>
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</tr>
<tr>
<td><strong>Adrenaline (Epinephrine)</strong></td>
<td>20mg in 250ml</td>
<td>G</td>
<td>C</td>
<td>0 -1 mcg/kg/min</td>
<td>Remove 20ml from the bag prior to adding 20ml (20mg) adrenaline Can be made double strength – (40mg in 250ml)</td>
</tr>
<tr>
<td>(Epinephrine 1:1000)</td>
<td></td>
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<td>ONLY</td>
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</tr>
<tr>
<td><strong>DERS programme available</strong></td>
<td></td>
<td></td>
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<tr>
<td><strong>Alfentanil</strong></td>
<td>25mg in 50ml</td>
<td>S, G, GS</td>
<td>C</td>
<td>0-10mg/hr</td>
<td>Can make double strength 50mg in 50ml</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>P</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Aminophylline</strong></td>
<td>Calculated dose in 100ml</td>
<td>S, G, GS</td>
<td>C</td>
<td>5mg/kg</td>
<td>Omit Loading dose if patient already receiving oral maintenance of Aminophylline/Theophylline</td>
</tr>
<tr>
<td>(loading dose)</td>
<td></td>
<td></td>
<td>P</td>
<td>(up to 500mg)</td>
<td></td>
</tr>
<tr>
<td><strong>DERS programme available</strong></td>
<td></td>
<td></td>
<td></td>
<td>20 mins</td>
<td></td>
</tr>
<tr>
<td><strong>Aminophylline</strong></td>
<td>500mg in 500ml</td>
<td>S, G, GS</td>
<td>C</td>
<td></td>
<td>Recommended 1st level 4-6 hours after the start of the infusion. Then daily levels. If patient fluid restricted: anecdotal use of 2mg/ml - 25mg/ml. 2mg/ml may go peripherally. Higher concentrations via central line only.</td>
</tr>
<tr>
<td>(maintenance infusion)</td>
<td></td>
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<td>P</td>
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<td></td>
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<tr>
<td><strong>DERS programme available</strong></td>
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</tr>
<tr>
<td><strong>Ambisome (Liposomal Amphotericin)</strong></td>
<td>Between 0.2-2mg/ml</td>
<td>G only.</td>
<td>C</td>
<td></td>
<td>Available as 50mg vials consider rounding dose to nearest 50mg. Requires 1mg test dose over 10 mins. Risk of anaphylaxis Flush before and after admin with G only. Incompatible with S</td>
</tr>
<tr>
<td>Critical Care Guideline available</td>
<td>See separate guideline</td>
<td></td>
<td>P</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Amiodarone</strong></td>
<td>300mg in 25ml</td>
<td>G</td>
<td>C</td>
<td>300mg over 30 mins</td>
<td>For patients &lt;50kg give 5mg/kg up to max 300mg Incompatible with S</td>
</tr>
<tr>
<td>(Loading dose)</td>
<td></td>
<td></td>
<td>ONLY</td>
<td>May be repeated once for unresponsive arrhythmias Infuse via a syringe driver</td>
<td>Use loading dose syringe label</td>
</tr>
<tr>
<td><strong>Network Guideline available</strong></td>
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<tr>
<td>Drug</td>
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</tbody>
</table>
| Amiodarone  
(24 hr maintenance infusion) | Day 1 900mg in 48ml  
Day 2 onwards 600mg / 900mg in 48ml  
See below for dosing when the oral route is not available. | G | C - Central  
P - Peripheral | 600- 900mg over 24 hours **infuse via a syringe driver** | Max dose in 24hrs: 900mg  
For low weight patients consider reducing dose to 600mg  
(based on 15mg/kg)  
**Incompatible with S**  
Use maintenance dose syringe label  
See guideline network to convert to maintenance dose once stable. |
| Amiodarone  
(Once daily maintenance dose when oral administration of the loading or maintenance dose is not possible)  
**Network Guideline available** | Desired dose made up to 25ml | G | C - Central  
P - Peripheral | Refer to network guideline for determination of dose required.  
Infuse over 60 mins | Consider this dose once patient is stabilized  
300mg IV daily is bio-equivalent to 200mg 3 x a day orally  
Tablets can be crushed and dispersed for NGT administration. |
| Argatroban  
250mg in 2.5ml | 250mg in 250ml | S or G | P | See trust wide guideline  
Heparin-Induced Thrombocytopenia (HIT)  
Recommended initial starting rate of 0.5mcg/kg/min (in critically ill patients) | Monitored via APTT ratio aiming for 1.5-3 times baseline value. (Not exceeding 100 seconds).  
Measure baseline APTT initially, then at two hours. |
| Atracurium  
(10mg/ml)  
**Critical Care NMBA Guideline** | 500mg in 50ml | Neat | C / P | Initial bolus dose of 0.5mg/kg followed by an infusion  
0 – 8 ml/hr | Monitor with a peripheral nerve stimulator (TOF). Establish TOF prior to the bolus dose.  
**Incompatible with Propofol** |
<table>
<thead>
<tr>
<th>Drug</th>
<th>Infusion concentration</th>
<th>Compatible Infusion fluid</th>
<th>Route</th>
<th>Usual Dosage Range</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcium gluconate 10% 1g in 10ml (2.26mmol Calcium in 10ml)</td>
<td>S</td>
<td>C, or large peripheral vein C ONLY for NEAT infusion</td>
<td>C - Central P - Peripheral</td>
<td>For urgent correction of acute severe hypocalcaemia / tetany or arrhythmias in hyperkalaemia add 10ml in 100ml (2.26mmol) and infuse over 10 mins. Alternatively 10ml (2.26mmol) may be given as a slow bolus over 5 minutes. Correction of severe hypocalcaemia in critical care 50ml (11.3mmol) UNDILUTED in a syringe administered over 2 hours with ECG monitoring</td>
<td>Dr AVAILABLE during urgent correction. NEVER EXCEED a rate 0.5mmol/min. ECG monitoring essential. Risk of asystole, bradycardia and hypotension with rapid IV administration. Ensure low magnesium levels are corrected MUST NOT be administered simultaneously with Ceftriaxone Check levels two hours post infusion A trust wide guideline for replacing severe hypocalcaemia using a large volume infusion over 24 hours exists. In practice this is rarely used within critical care due to the fluid volume and need to dedicate an IV line for the infusion period.</td>
</tr>
<tr>
<td>Caspofungin</td>
<td>Dose in 250ml</td>
<td>S only</td>
<td>C / P</td>
<td>Infuse over 1 hour Day 1: Loading dose 70mg Day 2: &gt;80kg: 70mg daily ≤80kg: 50mg daily</td>
<td>Alternative antifungal to liposomal amphotericin. Requires dose reduction in liver disease - see guideline.</td>
</tr>
<tr>
<td>Clonidine</td>
<td>750micrograms (5 amps) in 50ml</td>
<td>S, G</td>
<td>C / P</td>
<td>0-2micrograms/kg/hr Can be titrated to 3mcg/kg/hr in younger patients with normal renal function.</td>
<td>Monitor for hypotension and bradycardia, consider the need to reduce dose Risk of accumulation in renal failure reduce dose and review regularly</td>
</tr>
<tr>
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</tr>
<tr>
<td>Dalteparin (Fragmin) Critical Care guideline</td>
<td>10,000 units in 20ml</td>
<td>S</td>
<td>CVVH</td>
<td>Dose as per guideline for anticoagulant use in patients undergoing CVVH</td>
<td>Change syringe every 24 hours</td>
</tr>
<tr>
<td>Digoxin DERS programme available</td>
<td>62.5-500 micrograms in 50-100ml</td>
<td>S,G,GS</td>
<td>C/P</td>
<td>Loading dose infuse over 10-30 minutes, maintenance dose infused over 1-2 hours</td>
<td>ECG monitoring required for the loading dose.</td>
</tr>
<tr>
<td>Dobutamine DERS programme available</td>
<td>500mg in 100ml</td>
<td>G preferred S</td>
<td>C ONLY</td>
<td>0-20 micrograms/kg/min</td>
<td>Remove 40ml from the bag prior to adding 500mg (40ml) dobutamine. 1-2mg/ml may be infused into a large peripheral vein in an emergency post arrest</td>
</tr>
<tr>
<td>Epoprostenol for CVVH (Flolan) Critical Care Guideline</td>
<td>10,000 nanograms/ml</td>
<td>Reconstituted with buffer</td>
<td>CVVH</td>
<td>Continuous infusion CVVH 4 nanograms/kg/min (range: 3-8 nanograms/kg/min)</td>
<td>Dose as per guideline for anticoagulant use in patients undergoing CVVH</td>
</tr>
<tr>
<td>Erythromycin Network Guideline</td>
<td>250mg in 50ml</td>
<td>Add 20ml WFI to 1g further dilute with S</td>
<td>C/P</td>
<td>250mg twice a day as a prokinetic Infuse over 20-30 mins</td>
<td>Use for up to 7 days in combination with metoclopramide. Stop if watery diarrhoea develops</td>
</tr>
<tr>
<td>Esmolol DERS programme available</td>
<td>100mg in 10ml amps for bolus doses only 2.5g in 250ml ready made bag for infusions</td>
<td>Already diluted</td>
<td>C preferred or large peripheral vein</td>
<td>Treatment of tachyarrhythmias/hypertension during anaesthesia: 80mg bolus over 30 seconds then continuous infusion 50-200 microgram/kg/min Max 300mcg/kg/min</td>
<td>At consultant request only</td>
</tr>
<tr>
<td>Drug</td>
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<td>Compatible infusion fluid</td>
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<tr>
<td><strong>Furosemide</strong> (Frusemide)</td>
<td>50mg in 50ml</td>
<td><strong>S</strong></td>
<td><strong>C</strong> / <strong>P</strong></td>
<td>0 – 10ml /hr</td>
<td>Renal patients only</td>
</tr>
<tr>
<td><strong>Furosemide</strong></td>
<td>500mg in 50ml</td>
<td><strong>S</strong></td>
<td><strong>C</strong> / <strong>P</strong></td>
<td>Usually 1- 2 ml/hr</td>
<td></td>
</tr>
<tr>
<td><strong>Flumazenil</strong></td>
<td>2500 micrograms in 50ml</td>
<td><strong>G,S</strong></td>
<td><strong>C</strong> preferred or large peripheral vein</td>
<td>Initial rate for acute intentional overdose 500 micrograms/hr (10ml/hr) adjusted according to response within the dose range 100-2000 micrograms/hr (2-40ml/hr)</td>
<td>Stop infusion every 6 hours and assess whether re-sedation occurs. Full details in the trust-wide guideline available on the intranet.</td>
</tr>
<tr>
<td><strong>Gentamicin</strong> (Once daily dosing) <strong>Critical Care Guideline</strong></td>
<td>Calculated dose in 100ml</td>
<td><strong>G,S</strong></td>
<td><strong>C</strong> / <strong>P</strong></td>
<td>Use prescribing sticker to determine dose. Infuse over 60 mins</td>
<td>Dose dependant on renal function. In obesity dose based on Ideal or Dose Determined Body Weight - Calculation on antibiotic website. Monitor trough levels 18-24 hours after a dose as guideline.</td>
</tr>
<tr>
<td><strong>Glucagon</strong> Drug Kept in ED fridge at QMC</td>
<td>25mg/50ml (500microgram/ml)</td>
<td><strong>G</strong></td>
<td><strong>C</strong> preferred or large peripheral vein</td>
<td>Refer to guideline for full prescribing information. Bolus 2-10mg Infusion 50micrograms/kg/hr titrated to response.</td>
<td><a href="http://nuhnet/acute_medicine/edis_protocols/Adult%20Protocols/Forms/AllItems.aspx">http://nuhnet/acute_medicine/edis_protocols/Adult%20Protocols/Forms/AllItems.aspx</a></td>
</tr>
<tr>
<td><strong>Glyceryl trinitrate</strong></td>
<td>50mg in 50ml Vial</td>
<td><strong>Neat</strong></td>
<td><strong>C</strong> / <strong>P</strong></td>
<td>0.6 -12ml/hour (10-200micrograms/min) Up to 24ml/hr (400micrograms/min) has been used to control hypertension during surgery</td>
<td>Usual starting rate 1ml/hr and adjusted in 1ml/hr increments every 15 minutes. Infuse via syringe pump. Use polyethylene extension sets.</td>
</tr>
<tr>
<td>Drug</td>
<td>Infusion concentration</td>
<td>Compatible Infusion fluid</td>
<td>Route</td>
<td>Usual Dosage Range</td>
<td>Notes</td>
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</tr>
<tr>
<td>Heparin sodium</td>
<td>30,000 units in 30ml</td>
<td>Neat</td>
<td>C / P</td>
<td>Prescribe on and as per NUH heparin chart</td>
<td>See Local agreement for critical care nursing staff to adjust infusion rates as per APTT</td>
</tr>
<tr>
<td>Hydralazine</td>
<td>60mg in 60ml</td>
<td>S</td>
<td>C / P</td>
<td>Hypertensive emergencies: Initially 12-18ml/hr, reducing to maintenance of 3-9ml/hr once an adequate response is achieved</td>
<td>Incompatible with G Usually combined with beta blocker due to reflex tachycardia. Can be given as intermittent boluses. Dr available</td>
</tr>
<tr>
<td>Immunoglobulin</td>
<td>5g and 10g,20g</td>
<td>Infuse from bottle</td>
<td>C / P</td>
<td>Dosage as guideline Electronic request form on the Intranet MUST be completed by the consultant</td>
<td>Use the same brand of immunoglobulin per treatment course. Privigen 1st line for all patients. To ensure payment is not missed prescriber MUST document in the medical notes that the on line request form has been completed.</td>
</tr>
<tr>
<td>Insulin (Human Actrapid)</td>
<td>50 units in 50ml</td>
<td>S</td>
<td>C / P</td>
<td>Sliding scale Change infusion at 24 hrs giving set at 72 hrs.</td>
<td>Label a vial for individual patient use and store in patient locker. 28 days expiry once opened.</td>
</tr>
<tr>
<td>Insulin / Dextrose (Hyperkalaemia)</td>
<td>10 units to 50ml</td>
<td>G</td>
<td>C / P</td>
<td>Infuse over 30 mins</td>
<td>Consider need for cardio protection with calcium gluconate Monitor BMs after 15 mins , 30mins then hourly</td>
</tr>
<tr>
<td>Isoprenaline Sulphate</td>
<td>2.25mg in 50ml</td>
<td>G</td>
<td>C only</td>
<td>Start at 1.5ml/hr increasing by 1.5ml/hr every 2-3 mins to until satisfactory heart rate achieved or side effects max rate 15ml/hr (Usual dose range 1.125-11.25micrograms/min)</td>
<td>Unlicensed use of an unlicensed preparation Max rate of 20mcg/min reported. If rate needed make 4.5mg in 50ml ECG monitoring necessary. Risk of arrhythmias and hypotension In an Emergency may be used peripherally if diluted to 2.25mg in 500ml Glucose 5%</td>
</tr>
<tr>
<td>Drug</td>
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<tr>
<td>Ketamine (500mg in 10ml) (Treated as a CD)</td>
<td>1000mg in 20ml (for 1st syringe) (Increase to 2500mg in 50ml if high infusion rate)</td>
<td>Neat</td>
<td>C ONLY</td>
<td>0-2.5mg/kg/hour</td>
<td>Dose for bronchodilation in status asthmaticus. Always administer with background of midazolam to minimize hallucinations/vivid dreams Dilute to max 2mg/ml with S,G for peripheral administration.</td>
</tr>
<tr>
<td></td>
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<td></td>
<td>Start 0.5mg/kg/hr</td>
<td></td>
</tr>
<tr>
<td>Ketamine (500mg in 10ml) (Treated as a CD)</td>
<td>100mg in 50ml</td>
<td>S , G</td>
<td>C / P</td>
<td>0 - 5ml /hr</td>
<td>Post operative pain relief. Co-administered with opioids. Has opioid sparing effects Pre-printed Ketamine infusion prescription available</td>
</tr>
<tr>
<td>Labetalol via a CVC</td>
<td>300mg in 60ml (5mg/ml)</td>
<td>Neat</td>
<td>C ONLY</td>
<td>0 – 200mg / hr (0-40ml/hr) Higher doses occasionally used in the management of aortic dissection discuss with pharmacist.</td>
<td>Contra-indicated in asthmatics Can give as intermittent boluses 50mg repeated after 5minutes to a max of 200mg. Average duration of action approx 6 hours</td>
</tr>
<tr>
<td>Labetalol PERIPHERAL administration DERS programme available</td>
<td>500mg in 500ml (Or any bag size at 1mg /ml concentration)</td>
<td>S, G</td>
<td>C / P</td>
<td>0 – 200mg / hr (0-200ml/hr) Higher doses occasionally used as above</td>
<td></td>
</tr>
<tr>
<td>Magnesium sulphate 50% 2mmol/ml (1g = 4mmol) Hypomagnesaemia DERS programme available</td>
<td>20mmol in 100ml</td>
<td>S,G,GS</td>
<td>C / P</td>
<td></td>
<td>Infuse over 2 hours. Pre-printed on standard infusions chart.</td>
</tr>
<tr>
<td>Magnesium sulphate 50% 2mmol/ml (1g = 4mmol) Acute severe asthma and arrhythmias</td>
<td>8mmol in 50ml</td>
<td>S, G, GS</td>
<td>C / P</td>
<td>Stat 8mmol over 20mins</td>
<td>For asthma can give an infusion after the stat dose- see below.</td>
</tr>
<tr>
<td>Magnesium sulphate 50% 2mmol/ml (1g = 4mmol) Acute severe asthma (Continuous infusion)</td>
<td>80mmol in 250ml</td>
<td>S, G, GS</td>
<td>C / P</td>
<td>Continuous infusion 2g (8mmol) per hour =25ml/hour</td>
<td>Anecdotal use of continuous infusion limited evidence. Initially check serum magnesium levels every six hours to maintain the range 2-3mmol/l. Once stable check every 12 hours.</td>
</tr>
<tr>
<td>Drug</td>
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</tr>
<tr>
<td>Mannitol</td>
<td>20% (0.2g/ml)</td>
<td>500ml bag</td>
<td>C - Central</td>
<td>0.25 – 1 g/kg Stat infusion</td>
<td>For cerebral oedema. Monitor serum and urine osmolality. Serum osmolality should be &lt; 315 mosm/L. Do not administer at Y site with other drugs</td>
</tr>
<tr>
<td>Metaraminol</td>
<td>20mg in 40ml Or 10mg in 20ml if likely short duration of infusion</td>
<td>G or S P – via a large vein (ideally antecubital fossa)</td>
<td>0 – 10 mg/hr (0-20ml/hr) A typical starting rate 0.5mg/hr (=1ml/hr) unless guided by doctor titrate at 10 minute intervals</td>
<td>Bolus dose usually given by Dr prior to initiating an infusion. (see guideline for details) Emergency use prior to CVC line insertion.</td>
<td></td>
</tr>
<tr>
<td>Midazolam</td>
<td>1mg/ml or 2mg/ml</td>
<td>S, G, GS</td>
<td>C / P</td>
<td>0-20mg/hr</td>
<td>Accumulates in renal failure review dose regularly. Avoid Y site administration with Hartmann’s solution as this results in reduced potency.</td>
</tr>
<tr>
<td>Milrinone 10mg in 10ml</td>
<td>Loading dose: dilute dose to 10ml. Continuous infusion: 10mg in 50ml (200mcg/ml)</td>
<td>S, G Central preferred</td>
<td>Loading dose of 50micrograms/kg over 10mins, then a continuous infusion of 0.375- 0.75mcg/kg/min ( = 0.11-0.22 ml/kg/hr)</td>
<td>Total daily dose should not exceed 1.13mg/kg. Reduce maintenance dose in renal impairment.</td>
<td></td>
</tr>
<tr>
<td>Morphine</td>
<td>1mg/ml or 2mg/ml</td>
<td>S, G, GS</td>
<td>C / P</td>
<td>0- 20mg/hr</td>
<td>1st line sedative in combination with midazolam where normal renal function</td>
</tr>
<tr>
<td>Naloxone</td>
<td>4mg (10x 400mcg) made up to 20ml</td>
<td>S, G C/ large P vein</td>
<td>Infusion dosage as per guideline</td>
<td><strong>PGD exists</strong> for nurses to give slow IV bolus in 100mcg aliquots prior to the arrival of medical staff. For EMERGENCY USE: 5 x 400mcg Naloxone amps kept in anaphylaxis/over sedation box on arrest trolley. Dosing cards in the box http://nuhnet.nuh_documents/Guidelines/Trust%20Wide/Trust%20Wide/2050.pdf</td>
<td><strong>PGD exists</strong> for nurses to give slow IV bolus in 100mcg aliquots prior to the arrival of medical staff. For EMERGENCY USE: 5 x 400mcg Naloxone amps kept in anaphylaxis/over sedation box on arrest trolley. Dosing cards in the box http://nuhnet.nuh_documents/Guidelines/Trust%20Wide/Trust%20Wide/2050.pdf</td>
</tr>
</tbody>
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**Notes:**
- **C** Central
- **P** Peripheral
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</thead>
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<tr>
<td>Nimodipine</td>
<td>10mg in 50ml</td>
<td>Neat</td>
<td>C</td>
<td>Start at 5ml/hr for first 2 hours increasing to 10ml/hr provided BP permits</td>
<td>Incompatible with PVC. Infuse via syringe and dedicated polyethylene coated giving set. Infusion stable for 10 hours in artificial light. In an emergency may be administered into a large peripheral vein with a co-infusion on a 3 way tap of G, S or Hartmanns running at a minimum rate of 40ml/hr. For central administration ONLY, the co-infusion is often omitted.</td>
</tr>
<tr>
<td>Noradrenaline BASE (Norepinephrine)</td>
<td>20mg in 250ml or 4mg in 4ml amp</td>
<td>G</td>
<td>C</td>
<td>0-1 micrograms/kg/min</td>
<td>Noradrenaline Acid tartrate 2mg/ml is equivalent to 1mg/ml of Noradrenaline BASE. Remove 20ml from the bag prior to adding 20ml (20mg) noradrenaline. Can be made double strength 40mg in 250ml.</td>
</tr>
<tr>
<td>Omeprazole (High dose infusion)</td>
<td>Stat dose 80mg in 250ml infused over 1 hour Then 80mg in 250ml</td>
<td>S preferred G (see comments)</td>
<td>C</td>
<td>Stat dose followed by 8mg/hr (25ml/hr) for 72hrs</td>
<td>If prepared in S then 12 hour expiry. If prepared in G then only 6 hour expiry.</td>
</tr>
<tr>
<td>Omeprazole (daily dose)</td>
<td>40mg in 100ml daily</td>
<td>G or S</td>
<td>C</td>
<td>Infuse over 20-30 mins</td>
<td></td>
</tr>
<tr>
<td>Pabrinex (1 pair = amp 1 +2)</td>
<td>One or two pairs in 100ml</td>
<td>S, G</td>
<td>C</td>
<td>Infusion over 15-30mins</td>
<td>For doses see Trust alcohol withdrawal. For reducing risk of re-feeding syndrome dose is ONE pair ONCE a day for 3 days.</td>
</tr>
<tr>
<td>Drug</td>
<td>Infusion concentration</td>
<td>Compatible Infusion fluid</td>
<td>Route</td>
<td>Usual Dosage Range</td>
<td>Notes</td>
</tr>
<tr>
<td>------------------------------</td>
<td>------------------------</td>
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<td>-------------------</td>
<td>----------------------------------------------------------------------</td>
</tr>
<tr>
<td>Phenytoin (Loading dose)</td>
<td>Up to 1g in 100ml &gt;1g in 250ml</td>
<td>S</td>
<td>C / P</td>
<td>Over 20 - 30 mins Max rate 50mg/min Complete infusion within one hour of preparation</td>
<td>Loading dose 20mg/kg (max 2g) based on actual body weight BP and ECG monitoring recommended. Observe infusion to ensure no crystal formation. <em>Incompatible with Dextrose</em></td>
</tr>
<tr>
<td><strong>Phenytoin</strong> (Maintenance once daily)</td>
<td>Dose in 50ml</td>
<td>S</td>
<td>C / P</td>
<td>Over 20-30 mins Max rate 50mg/min</td>
<td>Starting dose 3-4mg/kg/d Average sized pts often receive 300mg daily Give as once daily IV infusion. <strong>Not NG in patients with 24 hour feeding +/- sliding scale insulin</strong></td>
</tr>
<tr>
<td>Potassium chloride PFS Local agreement for nurse administration</td>
<td>50mmol in 50ml</td>
<td>Neat</td>
<td>C ONLY</td>
<td>Infuse over 4 hours</td>
<td>Requires record of administration to be made in ward register. Consider NG Sando K (12mmol per tablet) if absorbing If clinically indicated may infuse at a faster rate. A new prescription MUST be written do not amend the pre-printed prescription. Usual maximum rate 40mmol/hr with ECG monitoring</td>
</tr>
<tr>
<td>Potassium Acid Phosphate 13.6% w/v</td>
<td>40mmol 40ml</td>
<td>C ONLY</td>
<td>Infuse over 6 hours</td>
<td>1ml of injection also contains 1mmol potassium. Use sodium glycerophosphate if high potassium level. Requires record of administration to be made in ward register. Consider NG Phosphate Sandoz (16.1mmol per tablet) if absorbing. If no central line premade bags of 9mmol in 250ml sodium chloride 0.9% may be used.</td>
<td></td>
</tr>
<tr>
<td>Propofol 1% DERS programme available</td>
<td>10mg/ml</td>
<td>Neat</td>
<td>C / P</td>
<td>0-4mg/kg/hour</td>
<td>See guideline for monitoring <strong>Change giving set and bottle every 24 hours</strong></td>
</tr>
<tr>
<td>Ranitidine Stress ulcer guideline available</td>
<td>50mg in 20ml Slow bolus over 2 minutes</td>
<td>G, S</td>
<td>C / P</td>
<td>Stress ulcer prophylaxis 50mg 3 x a day reduced to 2 x a day in severe Acute Renal Failure</td>
<td>Consider Naso-gastric Proton pump inhibitor Lansoprazole when absorbing or nasogastric ranitidine.</td>
</tr>
<tr>
<td>Drug</td>
<td>Infusion concentration</td>
<td>Compatible infusion fluid</td>
<td>Route</td>
<td>Usual Dosage Range</td>
<td>Notes</td>
</tr>
<tr>
<td>------</td>
<td>------------------------</td>
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<td>-------</td>
</tr>
<tr>
<td><strong>Remifentanil</strong>&lt;br&gt;(For use in burns patients for dressings changes).</td>
<td>1mg in 20mls or 2mg in 40mls</td>
<td>S/G</td>
<td>C / P</td>
<td>0-3nanograms/ml target site concentration (Minto model). Titrated according to response.</td>
<td>Administer using target controlled infusion (TCI) pump borrowed from theatres. To be administered on CCD by experienced consultant anesthetist only.</td>
</tr>
<tr>
<td><strong>Rocuronium</strong>&lt;br&gt;<strong>Critical Care NMBA Guideline</strong></td>
<td>500mg in 50ml</td>
<td>Neat</td>
<td>C / P</td>
<td>Initial bolus dose of 0.5mg/kg followed by an infusion 0 – 8ml/hr</td>
<td>In obese patients the dose should be calculated using ideal body weight. Monitor with a peripheral nerve stimulator (TOF). Establish TOF prior to the bolus dose.</td>
</tr>
<tr>
<td><strong>Salbutamol</strong></td>
<td>5mg in 500ml (10 micrograms/ml)</td>
<td>G, S (G preferred)</td>
<td>C / P</td>
<td>500microgram bolus given over 5-10 mins followed by an infusions. Usually start infusion at 300mcg/hour Range 180-1200mcg/hr</td>
<td>Can prepare concentrated infusion 10mg in 50ml Dex 5% in syringe (200mcg/ml). Can run centrally or peripherally</td>
</tr>
<tr>
<td><strong>Sodium bicarbonate 8.4%</strong>&lt;br&gt;(contains 1mmol/ml of bicarbonate and sodium)&lt;br&gt;DERS programme available</td>
<td>200ml Polyfusor</td>
<td>Neat</td>
<td>C ONLY</td>
<td>Rate according to indication</td>
<td>Concentrations over 1.4% via central line only</td>
</tr>
<tr>
<td><strong>Sodium chloride 2.7%</strong>&lt;br&gt;Critical Care guideline&lt;br&gt;DERS programme available</td>
<td>500ml Polyfusor</td>
<td>Neat</td>
<td>C ONLY</td>
<td>Rate according to guideline</td>
<td>Concentrations up to 1.8% may be given via large P vein</td>
</tr>
<tr>
<td><strong>Sodium glycerophosphate</strong>&lt;br&gt;(20mmol phosphate in 20ml)</td>
<td>20mmol diluted to 50ml</td>
<td>G,S</td>
<td>C ONLY</td>
<td>20mmol infused over 6 hours</td>
<td>Phosphate replacement where potassium acid phosphate unsuitable due to hyperkalaemia. Also contains 40mmol sodium</td>
</tr>
<tr>
<td>Drug</td>
<td>Infusion concentration</td>
<td>Compatible Infusion fluid</td>
<td>Route</td>
<td>Usual Dosage Range</td>
<td>Notes</td>
</tr>
<tr>
<td>---------------------------</td>
<td>------------------------</td>
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<td>-------</td>
<td>-------------------</td>
<td>----------------------------------------------------------------------</td>
</tr>
<tr>
<td>Sodium Nitroprusside</td>
<td>50mg in 250ml</td>
<td>G</td>
<td>C / P</td>
<td>Hypertensive crisis</td>
<td>start 30-90 micrograms/kg/hr. Increase by 30 micrograms/kg/hr every 5 minutes. Consider lower starting doses if on other antihypertensives (maintain on lowest dose possible average 180 micrograms/kg/hr) MAX dose = 480 micrograms/kg/hr. If BP not controlled after 10 mins at max dose then it should be stopped. Use in combination with other antihypertensives to minimize duration. Protect from light – cover infusion and wrap giving set in foil/ silver wrapper provided. Freshly prepared solution has faint orange-brown colour. Only discard if highly coloured. Infusion only stable for 24 hours. Avoid abrupt withdrawal; reduce over minimum of 15-30 mins.</td>
</tr>
<tr>
<td>Thiopental Sodium (Thiopentone)</td>
<td>1500mg in 60ml (25mg/ml) via a syringe driver</td>
<td>Reconstitute each 500mg vial with 20ml water for injections (WFI) (25mg/ml 2.5%)</td>
<td>C ONLY for infusion Bolus C/large P vein</td>
<td>1-3mg/kg Bolus (max 500mg) followed by infusion: For Status Epilepticus 1-5mg/kg/hr. Increased to 8mg/kg/hr if burst suppression EEG not achieved. Continue for 12-24 hours post seizure control then consider weaning. Traumatic brain injury 1-8mg/kg/hr Up to 12mg/kg/hr has been used. Can prepare 3000mg in 60ml for central administration only. (each 500mg with 10ml WFI) Discard infusions after 24 hours EEG monitoring required for infusions. For Obese patients base dose on lean body mass. In EMERGENCY situations 500mg can be diluted to 250ml (0.2%) (or 100mg in 50ml) with S or G and administered cautiously via a large peripheral line.</td>
<td></td>
</tr>
<tr>
<td>Drug</td>
<td>Infusion concentration</td>
<td>Compatible Infusion fluid</td>
<td>Route</td>
<td>Usual Dosage Range</td>
<td>Notes</td>
</tr>
<tr>
<td>------------------------------</td>
<td>------------------------</td>
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<td>-----------------------------------------------------------------------------------</td>
<td>---------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Tranexamic Acid</strong></td>
<td>Already in solution</td>
<td>S,G</td>
<td>C / P</td>
<td>Significant haemorrhage following trauma (as per CRASH 3 protocol) 1g in 100ml over 10 minutes followed by 1g in 500ml over 8 hours</td>
<td>Diluent volume not critical</td>
</tr>
<tr>
<td><strong>Vancomycin</strong></td>
<td>500mg in 100ml</td>
<td>S,G</td>
<td>C / P</td>
<td>Loading dose to be given based on actual body weight and independent of renal function. Followed a <strong>minimum</strong> of 12 hours later by maintenance dose which is determined according to renal function. Dose calculator on the antibiotic website</td>
<td>Monitor trough levels as per guideline. Can dilute up to 10mg /ml and give via a large peripheral vein if patient fluid restricted e.g. 1g in 100ml <strong>DERS programme available labelled Vancomycin via CVC</strong></td>
</tr>
<tr>
<td><strong>Critical Care Guideline</strong></td>
<td>750mg-1.25g in 250ml</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Critical Care Guideline</strong></td>
<td>1.5g-2g in 500ml</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Critical Care Guideline</strong></td>
<td><strong>Infuse at a rate not exceeding 10mg/minute</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Vasopressin - Argipressin</strong></td>
<td>20 units made up to 50ml in syringe</td>
<td>G</td>
<td><strong>C ONLY</strong></td>
<td>0.01-0.04 units/min (1.5ml - 6ml /hr) Suggested starting rate is 0.04 units/min</td>
<td>Used for Refractory Vasodilatory Shock Usually only considered when Noradrenaline dose greater than 0.5micrograms/kg/min</td>
</tr>
<tr>
<td>(Pitressin)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Critical Care Guideline</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Nursing staff may prepare and administer all infusions listed in the Critical care standard infusions chart against a valid prescription. For infusion fluids and concentrations outside those listed in the table please contact the Critical Care Pharmacist or On Call pharmacist for advice.*

**Unless otherwise stated all infusions should be changed after 24 hours.**

**Abbreviations**

<table>
<thead>
<tr>
<th>Route</th>
<th>C = Central venous catheter, Femoral or long line</th>
<th>P = Peripheral line</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluids</td>
<td>S= Sodium chloride 0.9%</td>
<td>G = Glucose 5%</td>
</tr>
<tr>
<td>DERS</td>
<td>Drug Error Reduction Software available on the Alaris volumetric pump. It is expected that this will be used to infuse the drug where available. A full list of medication available with a DERS programme is available in the folder.</td>
<td></td>
</tr>
</tbody>
</table>
References
The following references have been used for all drugs listed except where referred to specialist guidelines. Refer to individual guideline for reference details.

BNF-
British National Formulary accessed online at www.bnf.org Volume 68 Sep 14-March 2015

SPC-
Summary of Product Characteristics for individual drugs accessed online at www.medicines.org.uk October 2015

Micromedex-
Thompson Healthcare, Micromedex Healthcare series accessed online at www.thomsonhc.com October 2015

Medusa-


UCLH
Injectable medicines administration guide 3rd edition 2010

UKCPA

Document control/ supporting information for this clinical document

<table>
<thead>
<tr>
<th>Issue Date</th>
<th>Version</th>
<th>Comments</th>
</tr>
</thead>
</table>
| October 2015 |         | • Absolute alcohol intranet link updated and recommendation for Fomepizole treatment first line added
• Argatroban added and Danaparoid deleted. New agent for the management of heparin induced thrombocytopenia
• Calcium chloride entry deleted due to the discontinuation of the 10ml ampoules
• Calcium gluconate entry updated
• Clonidine addition of dose of up to 3mcg/kg/hr in young patients with normal renal function.
• Digoxin removed the need for doctor in attendance for the first dose
• Dopexamine removed as withdrawn from the UK market.
• Flumazenil concentration for infusion and rate of infusion changed as per 2015 trust wide guideline
• Glucagon updated bolus dose and infusion rate as per EDIS guideline 2015
• Immunoglobulin updated choice of immunoglobulin to privigen
• Updated Ketamine to a maximum of 2mg/ml for peripheral administration as per spinal prescription. Added details of Ketamine prescription. Removed concentrations. Only 500mg in 10ml stocked at NUH
• Labetalol removed doctor available. Changed dosage range to 0-200mg/hr with higher doses rarely used in aortic dissection.
• Metaraminol concentration changed to 0.5mg/ml to mirror theatres practice
• Naloxone updated PGD dose details and quantity in boxes.
• Potassium chloride added details regarding running at a faster rate. Included need for a new prescription rather than amending pre-printed local agreement prescription.
• Phosphate added in details of the premade 9mmol bag if no central venous access
• Propofol changed from ml/hr to max 4mg/kg/hr
• Tranexamic acid added infusion information for trauma patients
• Vancomycin added dose information for 500mg
• Added information for all drugs where DERS programme available on the alaris volumetric pump
• Added Remifentanil.
<table>
<thead>
<tr>
<th>Adrenaline</th>
<th>Alfentanil</th>
<th>Aminophylline</th>
<th>Amiodarone</th>
<th>Atracurium</th>
<th>Ciprofloxacin</th>
<th>Cis-atracurium</th>
<th>Clonidine</th>
<th>Digoxin</th>
<th>Dobutamine</th>
<th>Dopamine</th>
<th>Erythromycin</th>
<th>Fluconazole</th>
<th>Furosemide</th>
<th>Hartmann’s (Compound Sodium Lactate)</th>
<th>Heparin</th>
<th>Hydralazine</th>
<th>Insulin</th>
<th>Ketamine</th>
<th>Labetalol</th>
<th>Magnesium in NaCl 0.9%</th>
<th>Midazolam</th>
<th>Milrinone</th>
<th>Morphine</th>
<th>Nitroglycerin (Glyceryl trinitrate; GTN)</th>
<th>Noradrenaline</th>
<th>Phenytoin</th>
<th>Plasmalyte</th>
<th>Potassium Chloride</th>
<th>Potassium Acid Phosphate</th>
<th>Propofol</th>
<th>Rocuronium</th>
<th>Sodium bicarbonate</th>
<th>Thiopental</th>
<th>Vancomycin</th>
<th>Vasopressin</th>
</tr>
</thead>
</table>

Two drug Y-site Compatibility

**Incompatible at Y site**

**Compatible at Y site**

**Contact pharmacy for advice**

This chart is only applicable for drugs prepared and diluted as per the NUH Critical Care standard infusion chart 2016.

For other enquiries please contact either the Critical Care pharmacist or Medicines Information.

Out of hours please contact on-call pharmacist via switchboard.
Adult Critical Care Compatibility Information

Although the routine co-administration of drugs at Y site should be avoided wherever possible the following is a list of common drug infusion combinations when access is limited:

**Lumen One - Inotropes in Dextrose 5% in any combination:**

- Noradrenaline, Adrenaline or Dobutamine with Amiodarone
- Noradrenaline or Adrenaline with Neat Potassium chloride

**NB:** on CICU neat potassium chloride ideally should have a dedicated lumen (as part of the local agreement).

If no alternative of the following may be co-administered:

- Noradrenaline, Adrenaline, Milrinone or Dobutamine
- Noradrenaline, Adrenaline, Milrinone or Dopamine

**Lumen Two - Sedation in Sodium Chloride 0.9%:**

- Morphine or Alfentanil with Midazolam
- Morphine or Midazolam with Atracurium
- Alfentanil or Morphine with Propofol
- Alfentanil with Atracurium
- Midazolam with Propofol
- Morphine or Midazolam with Rocuronium

If there is no alternative the following combinations may be co-administered:

- Morphine, Midazolam and Propofol
- Morphine, Midazolam and Atracurium
- Alfentanil, Midazolam and Atracurium
- Midazolam, Morphine and Rocuronium
Plasmalyte compatibility information

**Background**

To date there is no published data regarding Intravenous Y site compatibility of plasmalyte with other drugs. The information provided below is based on stability studies undertaken at Nottingham University in conjunction with Nottingham Children's Hospital Paediatric Critical Care staff.

The concentrations of the drugs studied were much lower than used in adults; however, the drugs were studied as additive compatibility. For this reason Y site compatibility information has been extrapolated to the concentrations standardly used within Adult Critical Care

**Plasmalyte Y site compatibility with:**

1. **Morphine infusion and PCA** - 1mg/ml and 2mg/ml.
2. **Fentanyl PCA** - 500 micrograms in 50ml
   There is NO information on running plasmalyte with an Oxycodone PCA so this practice MUST still not occur.
3. **Clonidine** 750 micrograms in 50ml
4. **Ketamine** 100mg in 50ml
5. **Aminophylline** 1mg/ml and 2mg/ml

**Plasmalyte Y site Incompatibility with:**

1. Midazolam 1mg/ml and 2mg/ml
List of Medication with DERS Programme Available on Alaris Volumetric Pumps.

<table>
<thead>
<tr>
<th>Drug Name</th>
<th>Drug Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adrenaline</td>
<td>Magnesium Sulphate for electrolyte replacement</td>
</tr>
<tr>
<td>Aminophylline LOADING dose</td>
<td>Mannitol 20% /500mls</td>
</tr>
<tr>
<td>Aminophylline MAINTENANCE</td>
<td>Micafungin</td>
</tr>
<tr>
<td>infusion 1mg/ml</td>
<td></td>
</tr>
<tr>
<td>Aminophylline MAINTENANCE</td>
<td>Moxifloxacin</td>
</tr>
<tr>
<td>Infusion fluid restricted 2mg/ml</td>
<td></td>
</tr>
<tr>
<td>Caspofungin</td>
<td>Noradrenaline BASE</td>
</tr>
<tr>
<td>Ciprofloxacin</td>
<td>Omeprazole DAILY dose</td>
</tr>
<tr>
<td>Clarithromycin</td>
<td>Omeprazole INFUSION</td>
</tr>
<tr>
<td>Clindamycin</td>
<td>Omeprazole LOADING DOSE</td>
</tr>
<tr>
<td>Digoxin LOADING dose</td>
<td>Pabrinex</td>
</tr>
<tr>
<td>Digoxin MAINTENANCE dose</td>
<td>Phenytoin DAILY dose</td>
</tr>
<tr>
<td>Dobutamine</td>
<td>Phenytoin LOADING dose</td>
</tr>
<tr>
<td>Esmolol</td>
<td>Propofol 1%</td>
</tr>
<tr>
<td>Fluconazole</td>
<td>Sodium BICARB 1.26%</td>
</tr>
<tr>
<td>Gentamicin ONCE daily infusion</td>
<td>Sodium BICARB 1.4%</td>
</tr>
<tr>
<td>Glucose 10% 500ml bag</td>
<td>Sodium BICARB 8.4%</td>
</tr>
<tr>
<td>Glucose 20% 500ml bag</td>
<td>Sodium CHLORIDE 2.7% infusion for TBI</td>
</tr>
<tr>
<td>Glucose 20% 100ml bottle for</td>
<td>TPN</td>
</tr>
<tr>
<td>HYPO treatment</td>
<td></td>
</tr>
<tr>
<td>Labetalol PERIPHERAL</td>
<td>Vancomycin</td>
</tr>
<tr>
<td>Levetiracetam</td>
<td>Vancomycin VIA CVC for fluid restriction</td>
</tr>
<tr>
<td>Linezolid</td>
<td></td>
</tr>
</tbody>
</table>
Antibiotics –

Drugs that may be infused WITHOUT the need for a pump.

The following list of Intravenous antibiotics at individual practitioner discretion may be infused using a rate controller giving set rather than infusing via the Alaris pump.

Amoxicillin 2g IV
Benzylpenicillin 2.4g
Ceftazidime 2g
Ceftriaxone 2g
Erythromycin 250mg
Flucloxacillin 2g
Meropenem 2g
Metronidazole 500mg

Set rate controller to deliver infusion over 15-30 minutes according to requirements.

Due to the potential loss of up to 23ml in the giving set line, consider running a small volume infusion of the same diluent fluid post infusion.

A spiritmedical airguard safety plus rate controller giving set costs £0.58 per set

A Carefusion Alaris GP volumetric giving set costs £2.93 per set
GUIDELINES FOR THE PRESCRIBING AND ADMINISTRATION OF ABELCET

Indication: Abelcet is indicated for the treatment of severe invasive candidiasis.

Abelcet is also indicated as second line therapy for the treatment of severe systemic fungal infections in patients who have not responded to conventional amphotericin B or other systemic antifungal agents, in those who have renal impairment or other contra-indications to conventional amphotericin B, or in patients who have developed amphotericin B nephrotoxicity.

Abelcet treatment is indicated as second line treatment for invasive aspergillosis, cryptococcal meningitis and disseminated cryptococcosis in HIV patients.

Presentation: Abelcet 5mg/mL. Concentrate for Suspension for Infusion,
Yellow opaque suspension
Store at 2 - 8°C. Do not freeze. Keep vial in the outer carton.
Prescribe as Abelcet

Prescribing: Usual dose 3mg/kg escalated to 5mg/kg if insufficient response to treatment. 1mg/kg used for non invasive fungal infections. Refer to Haematology Antibiotic Guidelines for further information.

<table>
<thead>
<tr>
<th>Due to the cost of the vial - Consideration should be given to rounding the dose to the nearest 100mg to allow whole vials to be used. (Especially where patients weights have been estimated)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost per 100mg vial £82.13</td>
</tr>
</tbody>
</table>

Renal Impairment: No decrease in dose is needed in patients with renal failure or on Renal Replacement Therapy.

Monitoring: Renal and Liver function tests should be carried out before initiating therapy and at least weekly for the duration of treatment. Cessation of treatment should be considered if liver function deteriorates. Serum magnesium and potassium should be monitored and corrected regularly.

Common Side effects include:
Nausea and vomiting, diarrhoea, epigastric pain; febrile reactions, headache, muscle and joint pain; anaemia; disturbances in renal function (including hypokalaemia and hypomagnesaemia) and renal toxicity; also cardiovascular toxicity (including arrhythmias, blood pressure changes), blood disorders, neurological disorders (including hearing loss, diplopia, convulsions, peripheral neuropathy, encephalopathy), abnormal liver function, rash, anaphylactoid reactions, pain and thrombophlebitis at injection site.

For a full list of side effects please refer to the Summary of Product Characteristics (SPC) available via www.medicines.org.uk
Preparation: Abelcet will be made at the bedside by the patient’s named nurse. If you require stock please contact your Pharmacist. Out of Hours please contact the On-Call Pharmacist via switchboard.

1. Allow injection to warm to room temperature.
2. Shake gently until no yellow sediment is seen at the bottom of the vial.
3. Draw up the required volume of the injection into syringe(s).
4. Inject the dose into a glucose 5% infusion bag (do not use sodium chloride 0.9%) through the 5-micron filter needle provided.
5. Use fresh filter for each syringe.
6. Shake bag to thoroughly mix contents before starting infusion and repeat every 2 hours if infusion time exceeds 2 hours.
7. An in-line filter may be used for IV infusion (pore size no less than 15 micron)

The final infusion concentration: 1mg in 1mL (however 2mg in 1mL can be used in fluid restricted patients).

A Test Dose is required in ALL patients prior to the first infusion ONLY-

Test Dose:
1mg should be infused from the prepared bag over 15mins. The infusion should be stopped for 30 minutes and the patient observed. If no signs of allergic or anaphylactic reactions then the remainder of the bag may be administered.

Administration: Infuse at a rate not exceeding 2.5mg/kg/hr

References:

Guidelines for the Prescribing and Administration of Acetazolamide for metabolic alkalosis

**Indication:**
Acetazolamide can be used to promote the excretion of bicarbonate via the kidneys, correcting profound metabolic alkalosis. Within Critical Care the most common cause of the alkalosis is diuretic use, e.g. a furosemide infusion.

**Presentation:**
Acetazolamide 250mg tablets or 500mg powder for injection

**Prescribing:**
Usual adult dose: 250-500mg twice or three times a day for 48-72 hours. After this time if an improvement has not been seen treatment should be stopped as it is unlikely to have a beneficial effect beyond this timeframe.

Please use tablets first line and IV only if the patient isn’t absorbing enteral feed.

In practice the dose is not adjusted for acute renal failure or CVVH, but Arterial Blood Gases (ABGs) should be taken and the patient monitored for acidosis.

**Common Side effects include:**
Paraesthesia, some loss of appetite; taste disturbance, polyuria, flushing, thirst, headache, dizziness, fatigue, irritability, depression, and occasional instances of drowsiness and confusion. Rarely, photosensitivity has been reported.

For a full list of side effects please refer to the Summary of Product Characteristics (SPC) available via www.medicines.org.uk

**Monitoring:**
Regular ABGs should be undertaken and the pH and Bicarbonate monitored. Bicarbonate levels should decrease. Treatment can be stopped when the bicarbonate and pH levels fall into normal range (Bicarbonate 23-28mmol/L, pH 7.350 - 7.450)

**Preparation:**

**Enteral administration**
Tablets can be crushed and dispersed in water for administration via an enteral tube. Enteral administration is usually first line in patients absorbing due to the cost of the injection.

**IV administration:** Add 5ml water for injections to each 500mg vial and inject as a slow bolus over 3-5 minutes into a CVC or large peripheral cannula.

**References:**
5. Oxford Handbook of Critical Care; M. Singer, A. Webb; Oxford University Press; 2009
Background:
Radiocontrast induced nephropathy is the third commonest cause of hospital-acquired acute renal failure. Once Acute Kidney injury (AKI) develops there is no treatment, only supportive renal replacement therapy whilst awaiting resolution of the injury. Developing acute kidney injury is associated with a six and a half times increase in the risk of death compared to matched controls.

Radiocontrast nephropathy is proposed to be due to a combination of effects of osmotic toxicity, direct nephrotoxicity and impaired circulating volume. There is evidence that using iso-osmolar radio contrast, ensuring adequate hydration and using free radical scavengers such as N-acetylcysteine (NAC), reduces the incidence of Acute Kidney Injury.

Presentation: IV N-acetylcysteine 2grams (2000milligrams) in 10ml

Prescribing:
It has been agreed with radiology that all critical care patients and all intubated patients from the Emergency Department requiring radiocontrast studies will receive Visipaque contrast media. In addition those patients identified as at risk should receive N-Acetylcysteine pre- and post contrast media as follows:

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dose (milligrams)</th>
<th>In 500ml Nacl 0.9% over 30 mins.</th>
<th>Time given</th>
<th>Given by</th>
<th>Checked by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetylcysteine 150mg/kg</td>
<td></td>
<td>Started 30-60 mins prior to scan</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IV Iodixanol (Visipaque) Contrast</td>
<td>Dose</td>
<td>Radiologists signature</td>
<td>Time given</td>
<td>Given by</td>
<td>Checked by</td>
</tr>
<tr>
<td>Acetylcysteine 50mg/kg</td>
<td></td>
<td>Started on return from scan</td>
<td>Time given</td>
<td>Given by</td>
<td>Checked by</td>
</tr>
</tbody>
</table>

Obese patients
It is recommended that the dose of acetylcysteine is dosed on a maximum body weight of 110kg.

At risk patients
- Acute or chronic renal failure. Or patients with decreased urine output, a serum creatinine >130mmol/L or estimated CrCl <50ml/min
- Hypovolaemia. This should ideally be corrected prior to contrast administration
- Those receiving nephrotoxic drugs
- Diabetes mellitus
- Congestive Heart failure

Side effects
Nausea, vomiting, pulmonary oedema.
‘Hypersensitivity’ or Anaphylactoid type reactions include: flushing, itching, rash, bronchospasm, respiratory distress, hypotension and angio-oedema. These usually occur within 15-60mins of the start of the infusion. If a patient experiences a hypersensitivity type reaction the infusion must be stopped.
Relative contra-indications
Asthma or a history of bronchospasm.
Left ventricular failure.

References:
4. Royal College of Radiologists Standards for iodinated Intravascular Contrast agent administration to adult patients. Nov 2005. www.rcr.ac.uk
Acute Alcohol Withdrawal Pathway in Adults

Baseline Investigations:
U&E’s, LFT’s, blood glucose, magnesium & phosphate, FBC, clotting screen.
Refer to page 5 if suspected Wernicke’s encephalopathy. All patients with alcohol withdrawal symptoms should be referred to HADLT – see appendix 1

Table 1
Does the patient have >3 of the signs/symptoms listed below?
- Tremor (hands, tongue, eye lids)
- Raised blood pressure
- Tachycardia (>100bpm)
- Increased temperature
- Sweating (hands, face, forehead)
- Nausea/Vomiting/dry retching
- Anxiety
- Irritability
- Insomnia
- Hallucinations (auditory/visual)
- Reduced appetite
- Desire to drink alcohol
- Headache
- Malaise
- Agitation

Prescribe oral **chlor diazepoxide** reducing regime on ‘variable dose’ section of drug chart.

<table>
<thead>
<tr>
<th>Time</th>
<th>Day 1</th>
<th>Day 2</th>
<th>Day 3</th>
<th>Day 4</th>
<th>Day 5</th>
<th>Day 6</th>
<th>Day 7</th>
<th>Day 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>0800</td>
<td>20mg</td>
<td>20mg</td>
<td>20mg</td>
<td>10mg</td>
<td>10mg</td>
<td>10mg</td>
<td>10mg</td>
<td>S</td>
</tr>
<tr>
<td>1200</td>
<td>20mg</td>
<td>20mg</td>
<td>10mg</td>
<td>10mg</td>
<td>10mg</td>
<td>10mg</td>
<td>---</td>
<td>T</td>
</tr>
<tr>
<td>1800</td>
<td>20mg</td>
<td>20mg</td>
<td>10mg</td>
<td>10mg</td>
<td>10mg</td>
<td>---</td>
<td>---</td>
<td>O</td>
</tr>
<tr>
<td>2200</td>
<td>20mg</td>
<td>20mg</td>
<td>20mg</td>
<td>10mg</td>
<td>10mg</td>
<td>10mg</td>
<td>10mg</td>
<td>P</td>
</tr>
</tbody>
</table>

Also prescribe on the ‘as required’ section of drug chart:
**Oral chlor diazepoxide 20mg up to every hour if needed up to a maximum combined daily dose of 180mg daily.** (Please note specialist may increase this to 250mg daily under close supervision.)

Closely monitor patient for breakthrough alcohol withdrawal and administer when required chlor diazepoxide accordingly.

Chlor diazepoxide should NOT be prescribed on discharge to take home unless advised by specialist HADLT.

Caution in patients with respiratory depression/ severe hepatic insufficiency/ chronic psychosis.

Note: anaphylaxis is reported rarely with parenteral
Pabrinex® – resus facilities must be available

Prescribe on ‘regular prescription’ section of drug chart:
**Pabrinex 2 pairs IV three times a day for up to 5 days**
(minimum of 9 doses to be given)
(Dilute in 50-100ml of Sodium Chloride 0.9% and give over 30minutes)

After Pabrinex® course has been completed prescribe oral:
**Multivitamins ONE daily** and **Thiamine 100mg three times a day** both for 28 days.
(The need to continue will be reviewed in the community.)
**Prevention/Treatment of Wernicke’s Encephalopathy**

**Baseline Investigations:**
U&E’s, LFT’s, blood glucose, magnesium & phosphate, FBC, clotting screen
Note Chlordiazepoxide may or may not be needed in patients with WE. Please discuss with HADLT

If >1 of the following signs are identified in addition to poor diet or regular alcohol consumption a diagnosis of Wernicke’s Encephalopathy should be presumed until symptoms can be excluded by other diagnosis

- Ataxia*
- Confusion*
- Ophthalmoplegia*
- Nystagmus*
- Hypothermia
- Hypotension
- Memory disturbance
- Reduced consciousness

*Late symptoms of Wernicke’s Encephalopathy

If the patient has a history of alcohol consumption along with poor diet but does not have any of the signs in tables 1 or 2, prescribe Pabrinex® prophylactically.

**Pabrinex ONE pair IV once daily for up to 5 days**
(minimum of 3 doses to be given)
(Dilute in 50-100ml of Sodium Chloride 0.9% and give over 30 minutes)

Patients taking Vitamin B Compound Strong can continue taking this or it can be substituted with multivitamins if required as appropriate.

Followed by oral:

- **Multivitamins ONE daily** and **Thiamine 100mg three times a day** both for 28 days.
  (The need to continue will be reviewed in the community)

- Glucose can further deplete thiamine stores precipitating Wernicke’s-Korsakoff syndrome. Avoid if possible.
- Alcohol withdrawal syndrome can develop into complicated alcohol withdrawal syndrome or Delirium Tremens (DT).
- All patients with suspected DT should be referred to HADLT for management advice.
- For ‘Emergency Control of Acutely Disturbed Adult Patients’ please see separate guideline.
A Guideline for the Management of Acute Alcohol Withdrawal and Wernicke’s Encephalopathy in Adults.

It is important to recognise the signs and symptoms that may be displayed when a patient is dependent upon alcohol or in a state of alcohol withdrawal. Failure to identify these signs can result in a reduced patient outcome and increased risk of death. All patients admitted to NUH should be screened for their alcohol use. Please refer all patients who are showing signs of alcohol withdrawal to the Hospital Alcohol and Drug Liaison Team. Referrals can be made by any healthcare professional. See Appendix 1 for how to make referrals to the Hospital Alcohol and Drug Liaison Team (HADLT).

Appendix 1

Referring to Hospital Alcohol and Drug Liaison Team (HADLT)

1. Patient admitted/presents with alcohol withdrawal symptoms
2. Initial assessment/triage/clerking completed by ward or clinical area.
3. Patient on LJU, B3 D57 or F21 at QMC
   - HADLT attend ward at 8am and liaise with Nurse in Charge. Referrals identified
   - Patient assessed by member of HADLT
4. Patient on any other ward (QMC or CIT)
   - Refer patient to HADLT

HADLT Referrals Telephone Ext: **66384** or **0115 924 49924** via hospital switchboard

The following information is required:
- Patient name
- K Number/NHS Number
- Date of Birth
- Ward
- Referrer’s name/Position

If no answer leave a message with the above details and your call will be responded to within 1-2 hours or the following morning between the hours of 8am and 4pm Monday to Friday. If urgent help is required between 8am - 4pm Monday to Friday please call **07580 936 552** or **07870 686 444**. If urgent help is required outside these hours or at the weekend contact on call at Department of Psychological Medicine (DPM) via hospital switchboard or on ext 61292.

Self-Referral: Last orders for Nottingham City Resident on 0115 970 9590 or CRI Nottingham County Resident on 0115 896 0798
GUIDELINES FOR THE PRESCRIBING AND ADMINISTRATION OF AMBISOME

Indication:
Following microbiologist advice for Invasive Fungal infections where other treatments have failed or resistant species have been identified. Its use is often preferred to conventional Amphotericin B in patients on adult critical care due to its lower nephrotoxicity and risk of acute side effects.

For the management of neutropenic sepsis in haematology patients please refer to separate guideline.

Presentation: Liposomal Amphotericin B IV 50mg vial (yellow powder)
PRESCRIBE AS AMBISOME
Do not store above 25ºC

Prescribing:
For proven invasive fungal infections in critical care usual starting dose is 3mg/kg (based on actual body weight). Occasionally Microbiology may recommend higher doses. 1mg/kg may sometimes be recommended by microbiology for candida infections or as prophylaxis.

Due to the cost of the vial - Consideration should be given to rounding the dose to the nearest 50mg to allow whole vials to be used. (especially where patients weights have been estimated)
Cost per 50mg vial £87.90

Renal Impairment:
No dosage adjustment necessary for acute renal failure or during Renal Replacement Therapy.

Common Side effects include:
Rigors, pyrexia, chills and rash- increasing the infusion time to 2-3 hours will minimise this reaction, if necessary paracetamol, hydrocortisone and chlorphenamine can be given as pre-medication.
Electrolyte imbalances, particularly hyopkalaemia, hypomagnesiamia and hypocalcaemia.
Nausea and vomiting, Increased creatinine and blood urea- reversible on stopping the infusion. Vasodilation leading to tachycardia and flushing.

For a full list of side effects please refer to the Summary of Product Characteristics (SPC) available via www.medicines.org.uk

Monitoring:
Daily U&Es to assess deterioration in renal function and to detect electrolyte imbalances.
Full blood count at least twice weekly.
Preparation:

AmBisome will be made at the bedside by the patient’s named nurse. AmBisome is stocked on all critical care areas within the Trust.

1. Add 12ml water for injections to each 50mg vial. Due to a displacement value the total volume in the vial will be 12.5ml.
2. Immediately after the addition of the water shake vigorously for 30 seconds to completely disperse the yellow AmBisome powder. After reconstitution the concentrate is a translucent, yellow dispersion. Visually inspect the vial for particulate matter and continue shaking until complete dispersion is obtained. Do not use if there is any evidence of precipitation of foreign matter.
3. Calculate the volume of AmBisome needed and withdraw the required volume into a syringe.
4. Attach a 5 micron filter unit (provided with each vial) and a new needle to the syringe.
5. Add the drug via the filter to the Glucose 5% infusion bag. The final concentration should be between 1mg/ml and 2mg/ml:

| Doses up to 150 mg | 100 mL bag Glucose 5% |
| Doses 150 – 300 mg | 250 mL bag Glucose 5% |
| Doses > 300 mg     | 500 mL bag Glucose 5% |

Test Dose is required in ALL patients prior to the first infusion ONLY- See below:

Test Dose:

1mg should be infused from the prepared bag over 10mins. The infusion should be stopped for 30 minutes and the patient observed. If no signs of allergic or anaphylactic reactions then the remainder of the bag may be administered.

Administration:

Infuse over 30-60 minutes centrally or peripherally.
Incompatible with all electrolyte containing fluids (e.g. NaCl 0.9%), flush before and after administration with dextrose 5% (use 50ml Dextrose bag labelled as a flush for this purpose)

Bags prepared at ward level should be used immediately. If administration is delayed it must be used within SIX hours of reconstitution.

References:

AMIODARONE GUIDELINES

Clinical guidelines are guidelines only. The interpretation and application of clinical guidelines will remain the responsibility of the individual clinician. If in doubt contact a senior colleague or expert. Caution is advised when using guidelines after a review date. This guideline has been registered with the Mid Trent Critical Care Network.

Indications

- Stable patients with regular broad complex tachycardia or irregular narrow complex tachycardia / Atrial Fibrillation.
- Unstable patients with tachyarrhythmias after cardioversion attempted

For administration of Amiodarone in cardiac emergencies refer to the Advanced Life Support guidelines.

Amiodarone Indicated
Administer via central venous catheter ONLY

Repeat once if necessary for the treatment of AF if desired response not initially achieved

LOADING DOSE
300mg (6ml) diluted to 25ml with glucose 5% for administration over 30min (rate = 50ml/hour)

DAY 1
After loading dose give:
900mg (18ml) diluted to 48ml with glucose 5% for administration over 24 hours (rate = 2ml/hour)

Desired response achieved
Desired response not achieved

DAYS 2 - 7
If desired response not achieved
If desired response achieved

IV: 300mg (6ml) diluted to 25ml with glucose 5% for administration over 1 hour (rate = 25ml/hour) or
po/ng: 200mg TDS

DAYS 8 - 14
IV: 200mg (4ml) diluted to 25ml with glucose 5% for administration over 1 hour (rate = 25ml/hour) or
po/ng: 200mg BD

DAYS 2 - 7
600mg (12ml) diluted to 48ml with glucose 5% for continuous administration over 24 hours (rate = 2ml/hour)

Review daily
Review need for amiodarone on discharge from critical care

If not well controlled consider increasing dose for further 24-48 hrs then re-review

If not well controlled, refer to clinician

DAY 15+
IV: 100mg (2ml) diluted to 25ml with glucose 5% for administration over 1 hour (rate = 25ml/hour) or
po/ng: 200mg OD
Amiodarone Guidelines Additional Information

- Peripheral administration:
  - In situations where a central venous catheter is not present, additional dilution is required for peripheral administration. Suitable volumes are 250ml glucose 5% for 300mg doses, and 500ml glucose 5% for 900mg doses.
  - This guideline does not cover Amiodarone administered in a resuscitation situation.

- Ensure that Hypomagnesaemia or Hypokalaemia are corrected as necessary.
- When switching from the intravenous infusion to oral Amiodarone, it is recommended that the first oral dose should be given 16 to 24 hours before stopping the IV infusion.
- Oral bioavailability is approximately 50%, i.e. 100mg IV approx = 200mg PO.
- Tablets may be crushed and dispersed in water for administration via an enteral feeding tube.
- Acute adverse effects include bradycardia and hypotension. Consider the need to discontinue the infusion.
- It is recommended to check liver and thyroid function tests prior to initiating Amiodarone.
- Amiodarone has a number of significant drug interactions. Of particular note are:
  - Phenytoin
  - Warfarin
  - Digoxin.
  - Caution should be used when used alongside medication that can extend the QTc interval.

These guidelines have been produced by the Mid-Trent Critical Care Network Pharmacy Group with the aim of standardising the administration of Amiodarone across the network. Amiodarone should be administered via non-DEHP (di-2-ethylhexylphthalate - a plasticizer) containing equipment or devices due to the possibility of Amiodarone causing the leaching of DEHP out of bags or giving sets. DEHP has been shown in rat studies to be carcinogenic. The use of a syringe pump with a PE coated giving set will reduce DEHP exposure.

References

5. Amiodarone guidelines – University Hospitals of Leicester NHS Trust. K. Teare, B Pattani Pharmacy Department 2001
Guidelines for the Prescribing and Administration of Anidulafungin

Indication:
This is the echinocandin antifungal of choice for treatment of non-haematology adult patients within NUH. For haematology patients please refer to the Caspofungin monograph.

To be prescribed following Consultant microbiologist, or Infectious Diseases advice for Invasive Candidiasis or where resistant species have been identified. It is not indicated for CNS fungal infections where Mucor species have been identified or Cryptococcus neoformans.

Presentation:
Available as 100mg vials containing a white powder. The vials are stored in the fridge; however they are stable at up to 25 degrees Celsius for less than 96 hours and can be returned to the fridge if unused.

Prescribing:
Usual adult dose is 200mg (LOADING DOSE) on day one, followed by 100mg once daily thereafter.

No dosage adjustment is needed for ACUTE KIDNEY INJURY, during CVVH/HDF or Hepatic impairment.

Common Side effects include:
Hypokalaemia (>1 in 10), hyperglycaemia, hypotension, hypertension, flushing, bronchospasm, vomiting, abdominal pain, rash, deranged LFTs including cholestasis, raised creatinine.

For a full list of side effects please refer to the Summary of Product Characteristics (SPC) available via www.medicines.org.uk

Monitoring:
Liver function tests and electrolytes.

Preparation:
Anidulafungin will be made at the bedside and is stocked in all critical care areas.

200mg loading dose:
1. Add 30mL water for injection to each 100mg vial. Reconstitution may take up to 5 minutes.
2. Remove 50mL from a 250mL sodium chloride 0.9% or glucose 5% bag, then add the reconstituted anidulafungin to the 200mL bag.
3. Infuse over minimum of 3 hours (180minutes).

100mg dose:
1. Add 30mL water for injection to each 100mg vial. Reconstitution may take up to 5 minutes.
2. Add reconstituted anidulafungin to 100ml of sodium chloride 0.9% or glucose 5%.
3. Infuse over minimum of 1.5 hours (90minutes).
References:


Bowel management guideline in Adult Critical Care:

**Exclusion**

DO NOT USE IN
1. Hepatic encephalopathy
2. Spinal cord injury patients
3. Post bowel or vascular surgery (unless agreed by surgical team)
4. Pregnant Patients

**High risk for constipation:**
- Mechanical ventilation for >24hrs
- Vasopressors > 0.2mcg/kg/min
- Opioids IV/NG
- Muscle relaxant infusion
- History of constipation
- Multi-organ failure

---

**Admission to Critical Care:**

- **Enteral feed**
  - NO: Continue with enteral feed
  - YES: Proceed to the aperient ladder

**High risk of constipation**

- NO: Continue with enteral feed
- YES: Proceed to the aperient ladder

**Aperient ladder (Enteral aperients):**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>GUIDELINE FAILURE</td>
</tr>
<tr>
<td>E</td>
<td>D + Phosphate enema 1 PR</td>
</tr>
<tr>
<td>D</td>
<td>B + Movicol 2 sachets twice daily</td>
</tr>
<tr>
<td>C</td>
<td>B + Movicol 1 sachet twice daily</td>
</tr>
<tr>
<td>B</td>
<td>Senna 15mg twice daily and Sodium Docusate 200mg twice daily</td>
</tr>
<tr>
<td>A</td>
<td>No aperients</td>
</tr>
</tbody>
</table>
Daily assessment of bowel motions

- >72 hrs since bowels last opened
- Bowels open?
  - Yes: Stool consistency
    - Bristol 1-2: Climb one step on aperient ladder
    - Bristol 3-5: No change
    - Bristol 6-7: Drop two steps on aperient ladder
  - No: Bowels open in 24hrs
    - Yes: Continue on ladder rung that produced results
    - No: Bowels open within 4 hrs?

Document clinical exam and PR daily

- Rectum empty: Climb 1 step on aperient ladder
- Rectum full: Commence or climb one step on enema ladder

Enema ladder (Rectally):

<table>
<thead>
<tr>
<th>Letter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Z</td>
<td>GUIDELINE FAILURE</td>
</tr>
<tr>
<td>Y</td>
<td>Phosphate enema 1</td>
</tr>
<tr>
<td>X</td>
<td>Microlax enema 2</td>
</tr>
<tr>
<td>W</td>
<td>Microlax enema 1</td>
</tr>
<tr>
<td>V</td>
<td>Glycerin suppositories 2</td>
</tr>
</tbody>
</table>
Guideline Failure

- AXR to rule out obstruction
- Neostigmine 2.5mg IV over 10 minutes if pseudo-obstruction diagnosed-
  CONSULTANT ONLY prescription.
- If not pseudo-obstruction but constipation – give 2 sachets of Picolax NG
- If adverse features: feed intolerance, vomiting or abdominal distension-refer for
  surgical opinion

Neostigmine

The use of IV Neostigmine for Pseudo obstruction is an OFF label indication. Pseudo-
obstruction is defined as a massive dilatation of the colon in the absence of mechanical
obstruction, that can develop after surgery or critical illness.

Presentations

Neostigmine 2.5mg in 1ml injection OR
Neostigmine 2.5mg with Glycopyrronium 500 micrograms (Robinul)

Administration

2.5mg Neostigmine or Neostigmine/ glycopyrronium diluted to 10ml with sodium chloride 0.9%
infused over 10 minutes. Set infusion pump to 60ml/hr.

If effective, response time is usually between 4-30mins. Can be repeated after 3 hours.

Contra-indications

- Recent bowel anastomosis
- Caution in renal impairment (may require dose reduction)

Potential side effects

- Bradycardia, hypotension
- Increased sweating and salivation
- If bradycardia symptomatic may require Atropine or Glycopyrronium

Reference:

   1999;137-41
GUIDELINES FOR THE PRESCRIBING AND ADMINISTRATION OF
CASPOFUNGIN

Indication:
To be prescribed following microbiologist advice for Invasive Candidiasis where other
treatments have failed, or resistant species have been identified. It is not indicated for CNS
fungal infections where Mucor species have been identified, or for first line treatment of
Aspergillosis. Casopfungin is to be used in Haematology patients only.

Presentation:
Available as 70mg and 50mg vials containing a white to off-white powder. The vials are stored
in the refrigerator and should be warmed to room temperature prior to preparing the required
dose.

Prescribing:
A loading dose of 70mg should be prescribed on day one for all patients on the ‘Once Only’
section of the treatment chart. This dose is irrespective of renal and hepatic function, weight
and age.

From Day two onwards patients should continue to receive 70mg OD unless:
- The patient weighs less than 80kg. In this case a dose of 50mg OD should be
  prescribed.
- The patient has moderate hepatic insufficiency (Child Pugh score 7-9) a dose reduction
to 35mg OD may be necessary- please discuss with a Pharmacist. There is no clinical
experience of using caspofungin in patients with severe hepatic insufficiency(Child Pugh
Score >9); therefore if possible treatment should be avoided, if treatment is unavo idable
discuss with a Pharmacist.
- In grossly obese patients, as plasma concentrations decrease with increasing weight it
may be more appropriate to use AmBisome first line.
- When Co-administering inducers of metabolic enzymes, an increase in the daily dose of
Caspofungin should be considered, Discuss with a Pharmacist

No dosage adjustment are needed for acute renal failure or during CVVH

Common Side effects include:
Thrombo-phlebitis, fever or chills, nausea, vomiting, diarrhoea, abdominal pain, anaemia,
hypokalaemia, hyperhidrosis, elevated LFT’s, rash and puritis.
Rarely bronchospasm, anaphylaxis and acute renal failure has been reported following
administration of caspofungin.

For a full list of side effects please refer to the Summary of Product Characteristics (SPC)
available via www.medicines.org.uk

Monitoring:
Liver function tests and electrolytes should be performed daily.
Preparation guidelines:
Please use the correct vial size for the dose. If you require further stocks please contact your Pharmacist. Out of Hours please contact the On-Call Pharmacist via switchboard.

1. To reconstitute the powder, bring the vial to room temperature and aseptically add 10.5 ml of water for injection. The concentrations of the reconstituted vials will be 5.2 mg/ml (50 mg vial) or 7.2 mg/ml (70 mg vial). The powder will dissolve completely. Mix gently until a clear solution is obtained. Reconstituted solutions should be visually inspected for particulate matter or discolouration.
2. Dilute required dose in 250ml Sodium Chloride 0.9%. (For doses of 35mg please discuss with the Critical Care Pharmacist as it may be possible to have this manufactured in SPU to facilitate cost savings as 2 doses can be manufactured from one 70mg vial.)
3. Infuse over 60 minutes.
4. Flush using Sodium Chloride 0.9%

**Caspofungin is incompatible with dextrose containing fluids.**

References:

ADULT CRITICAL CARE GUIDELINES FOR ANTICOAGULANT USE IN PATIENTS UNDERGOING CONTINUOUS VENOVENOUS HAEMOFILTRATION

Introduction

Severe acute renal failure (ARF) is a common complication in critically ill patients with multi-organ failure. Continuous renal replacement therapies (CRRT) such as continuous venovenous haemofiltration / haemodiafiltration (CVVH / CVVHDF) are well established treatment modalities for supporting such patients. Successful application of CRRT depends on adequate extracorporeal circuit (EC) life. Maintenance of CVVH / CVVHDF circuits for sufficient duration is therefore important to prevent recurrent filter clotting and the need for frequent filter replacement. This promotes maximal filtration efficiency, cost effectiveness and minimizes blood component loss.

Exposure of blood to the EC is thrombogenic. Duration of EC life is thus reliant on anticoagulation in order to allow the continued passage of blood through the EC over a prolonged period of time. The need for anticoagulation has to be balanced against the increased risk of bleeding in high-risk patients. The systemic anticoagulation techniques used to prevent clotting of the EC are important causes of morbidity during CRRT. Several drugs can be used as anticoagulants to facilitate CRRT. Unfortunately, none have ideal pharmacokinetic and pharmacodynamic properties and all pose a potential risk to the patient through their side-effect profiles.

There is little evidence for superiority of one drug over another and the anticoagulant regime should be tailored to the needs of the individual patient. The options currently available for use within the Adult Critical Care directorate at Nottingham University Hospitals NHS Trust are:

- Dalteparin (Fragmin)
- Unfractionated heparin
- Epoprostenol (Flolan) (ask pharmacist for guideline)
- No Anticoagulation.

Argatroban infusions are indicated in cases of Heparin Induced Thrombocytopenia (HIT) see trustwide guideline.

Aims of anticoagulation for CVVH / CVVHDF

1. To achieve an acceptable EC life-span to allow clearance of measurable waste products, maximise filtration efficiency and improve cost effectiveness.

2. To minimise the risk of bleeding and blood product replacement.

Prior to commencement of the CVVH / CVVHDF the patients coagulation state should be assessed to identify any coagulation abnormalities and to determine the most suitable anticoagulant therapy.
Options for the anticoagulation of patients undergoing CVVH on AICU

Dalteparin (Fragmin)

Although no conclusive evidence exists to support the use of one anticoagulant over another a decision has been made within Nottingham University Hospitals NHS Trust to use the Low Molecular Weight Heparin (LMWH) Dalteparin (Fragmin) as a first line agent due to its safety profile and ease of monitoring. Dalteparin causes effective inhibition of factor Xa, but due to their smaller size they are not able to form a complex with anti IIa (antithrombin). It has proven safety and equal efficacy compared to unfractionated heparin. Therapy can be monitored by measuring anti-Xa activity, however in practice this is not usually clinically necessary. Limited access to timely anti-Xa heparin activity assays and non-validated therapeutic ranges for anti-Xa heparin levels means that anti-Xa levels are only rarely measured. Increases in APTT or activated clotting time may occur but are not linearly related to antithrombotic activity and are therefore unsuitable methods for monitoring therapy.

Epoprostenol (Prostacyclin – Flolan)

Epoprostenol a prostaglandin is a potent inhibitor of platelet aggregation and a powerful smooth muscle relaxant producing profound vasodilation. It is an alternative to heparins in certain patients with abnormal clotting parameters or the use of LMWH is contra-indicated. It has a very short half-life of only 3 minutes and is therefore given by continuous infusion. Side effects include hypotension, flushing, bradycardia headache, nausea and vomiting. Due to its short half-life these wear off quickly upon cessation of the infusion. Epoprostenol is rarely used as those patients at increased of bleeding are likely to undergo CRRT with either a reduced LMWH dose or completely without anticoagulation.

Unfractionated heparin

See appendix 1

No anticoagulation

Used in patients with deranged clotting profiles or low platelets. No anticoagulation is an acceptable practice in those with contra indications to anticoagulants. In the literature the filter life is equivalent to other drug regimens with similar complication rates.
1. PATIENTS WITH NORMAL / MILDLY DERRANGED CLOTTING PARAMETERS

Where clotting is normal to moderately deranged (see table 1) and the patient is assessed to be at low risk of bleeding complications, Dalteparin is the anticoagulant of first choice for CVVH / CVVHDF.

Table 1. Clotting parameters defining normal to moderate coagulopathy

<p>| | |</p>
<table>
<thead>
<tr>
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<tbody>
<tr>
<td>APPT</td>
<td>&lt;45</td>
</tr>
<tr>
<td>Platelets</td>
<td>&gt;100</td>
</tr>
<tr>
<td>INR</td>
<td>&lt;1.5</td>
</tr>
</tbody>
</table>

**Prescription**

10,000 units of DALTEPARIN (FRAGMIN) made up to a total of 20mls with sodium chloride 0.9% (Concentration 500 units/ml)

*Syringes should be changed every 24 hours*

**Loading dose of DALTEPARIN**: 20 units/kg.

**Followed by a recommended infusion rate of**: 5 - 10 units/kg/hr

The bolus should be administered to the patient as soon as possible after blood flow into the circuit has been established in order to initiate anticoagulation. If the filter has already been running and the circuit has had to be changed, a bolus should only be given again if the filter has been off for a period of four hours or more. To maintain anticoagulation commence the continuous infusion of Dalteparin, via the integral anticoagulant line as soon possible.

If more than TWO filters have clotted in the last twelve hours AND there are no access related problems, then with the next filter commencement use:

**Loading dose of DALTEPARIN**: 30 units/kg

**Followed by a recommended infusion rate of**: 10 - 15 units/kg/hr

At this stage if the filter appears to be clotting you may increase the pre-dilution flow rate
2. PATIENTS WITH ABNORMAL CLOTTING PARAMETERS OR INCREASED RISK OF HAEMORRHAGE

Table 2 defines those patients at high risk of bleeding secondary to deranged clotting parameters.

Table 2. Clotting parameters defining high risk coagulopathy

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
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<tbody>
<tr>
<td>APPT</td>
<td>&gt;45</td>
</tr>
<tr>
<td>Platelets</td>
<td>&lt;100</td>
</tr>
<tr>
<td>INR</td>
<td>&gt;1.5</td>
</tr>
</tbody>
</table>

The following represent conditions in which the use of anticoagulation with CVVH may result in unacceptable risk of bleeding complications.

- Surgery in the last 24 hours or planned in the next 24 hours
- Significant bleed in past 48 hours (as evidence by +2 unit blood transfusion, correction of clotting with haematological products, haemodynamic instability because of blood loss)
- Ongoing bleeding

In such cases **NO ANTICOAGULATION SHOULD BE USED** but changes in the pre and post dilution ratios may be required\(^1,3\).

**Monitoring**

Generally this is not necessary. Limited access to timely anti-Xa heparin activity assays and nonvalidated therapeutic range for anti-Xa heparin levels mean that anti-Xa levels are only rarely measured. The effectiveness of anticoagulation is based upon filter life and anti-Xa activity.

The therapeutic levels of anti-Xa should be

\[
0.6 - 1.2 \text{ iu/ml}
\]

If required, the anti-Xa sample should be a systemic blood sample and can be measured daily **Monday to Friday** at the QMC campus. This should not be a routine measurement however.

In the event of:

- Clinical signs of bleeding
- Poor haemofilter function due to increased clotting
- Persistent filter life of less than 12 hours with no other reason

Samples can be sent with Critical Care consultant approval.
Appendix 1:

Anti-coagulation of the filter with unfractionated heparin

Unfractionated heparin is used very rarely in adult critical care for anti-coagulation via the filter. If it is required please follow the information below.

A copy of CICU’s hemofiltration prescription chart MUST be obtained if heparin anti-coagulation is required.

For patients receiving concomitant IV heparin infusions for other indications further heparin via the filter circuit is not required. This patient group should receive heparin via the IV route only, either via CVC or peripheral cannula. This is so there is no interruption of anti-coagulation if the filter clots off or stops.

Unfractionated heparin prescription:

Loading dose: Unfractionated heparin 75 units/kg (Max 5000 units) by direct IV injection immediately prior to filter connection before heparin infusion starts.

Continuing infusion: Unfractionated heparin 20,000 units/20 ml. Made up in a BD luer lock syringe and attached to the integral anticoagulant line of the prismaflex filter.

Starting rate:

<table>
<thead>
<tr>
<th>Weight of patient in kg</th>
<th>Flow rate of heparin in ml/hr</th>
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<tbody>
<tr>
<td>&lt;70</td>
<td>1</td>
</tr>
<tr>
<td>71-75</td>
<td>1.1</td>
</tr>
<tr>
<td>76-80</td>
<td>1.2</td>
</tr>
<tr>
<td>81-95</td>
<td>1.3</td>
</tr>
<tr>
<td>&gt;95</td>
<td>1.4</td>
</tr>
</tbody>
</table>

Heparin monitoring:

APTT ratio MUST be monitored whilst the patient is receiving heparin anticoagulation via the filter and the rate adjusted according to this.

APTT ratio should be checked:
- Prior to starting heparin.
- 4-6 hours after the start of the heparin infusion.
- 4-6 hours after an infusion rate change.
- At least once every 24 hours once the infusion rate is stable.

APTT ratio and continuing rate:

<table>
<thead>
<tr>
<th>APTT ratio</th>
<th>Adjustment of IV heparin dose</th>
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</thead>
<tbody>
<tr>
<td>Above 7</td>
<td>Reduce rate of infusion by 0.5 mls/hr (500 units/hour)</td>
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<tr>
<td>5.1-7.0</td>
<td>Reduce rate of infusion by 0.5 mls/hr (500 units/hour)</td>
</tr>
<tr>
<td>4.1-5.09</td>
<td>Reduce rate of infusion by 0.3 mls/hr (300 units/hour)</td>
</tr>
<tr>
<td>3.6-4.09</td>
<td>Reduce rate of infusion by 0.2 mls/hr (200 units/hour)</td>
</tr>
<tr>
<td>2.6-3.59</td>
<td>Reduce rate of infusion by 0.1 mls/hr (100 units/hour)</td>
</tr>
<tr>
<td>1.5-2.59</td>
<td>NO CHANGE</td>
</tr>
<tr>
<td>1.2-1.49</td>
<td>Increase rate of infusion by 0.2 mls/hr (200 units/hour)</td>
</tr>
<tr>
<td>&lt;1.2</td>
<td>Increase rate of infusion by 0.4 mls/hr (400 units/hour)</td>
</tr>
</tbody>
</table>

Nurses initiating a change to administration rate according to APTT must have a local agreement in place to support their practice.
Changes in administration rate must be recorded on the haemofiltration prescription chart, which has been obtained from CICU.

**PLEASE NOTE:** In the event of a patient requiring less than 0.5ml/hr of heparin it is not possible to run this with the heparin syringe attached directly to the prismaflex filter. Due to the low rate of infusion the heparin syringe needs to be run via a separate infusion pump and the line attached to the anticoagulant line of the prismaflex filter.

FBC and platelets should be monitored daily while on heparin. Consider stopping heparin if platelets are falling, in this case contact haematology for advice.

If bleeding occurs stop the heparin infusion and contact a doctor.

**References**

GUIDELINES FOR IV ANTIBIOTIC DOSING DURING CONTINUOUS RENAL REPLACEMENT THERAPIES IN PATIENTS WITH ACUTE RENAL FAILURE

This is aimed as a practice based guideline based on available literature and anecdotal in practice experience of the MTCCN Critical Care Pharmacists. The information provided assumes dosing for an average sized adult where the filtration machine is running uninterrupted. Principles of dosing for some antibiotics are based on the idea of giving a loading dose depending on indication for the critically unwell patients whilst balancing the potential for side effects from drug accumulation.

<table>
<thead>
<tr>
<th>Drug Name</th>
<th>Dosage in Normal Renal Function</th>
<th>Dosage during CVVH</th>
<th>Dosage during CVVHDF</th>
<th>Action taken in CVVH interrupted for &gt;4-6 hours where Urine Output &lt;10ml/hr</th>
<th>Removal of drug by CRRT</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abelcet</td>
<td>1-5mg/kg OD</td>
<td>As normal renal function</td>
<td>As normal renal function</td>
<td>As normal renal function</td>
<td>No</td>
<td>Less nephrotoxic than amphotericin but still potential for toxicity.</td>
</tr>
<tr>
<td>Aciclovir</td>
<td>Encephalitis: 10mg/kg TDS / 5-10mg/kg OD</td>
<td>5mg-10mg/kg OD</td>
<td>5mg-10mg/kg OD</td>
<td>2.5 - 5mg/kg OD monitor renal function*</td>
<td>Yes</td>
<td>Aciclovir has potential to worsen renal function ensure adequate hydration. Dose on IBW/DDW Levels may be measured at Bristol reference lab if *clinically indicated/diagnosis confirmed.</td>
</tr>
<tr>
<td>Ambisome</td>
<td>3mg/kg OD / 1mg/kg for prophylaxis / 5mg/kg on micro advice</td>
<td>As normal renal function</td>
<td>As normal renal function</td>
<td>As normal renal function</td>
<td>No</td>
<td>Less nephrotoxic than amphotericin but still potential for toxicity.</td>
</tr>
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<tr>
<td>Amikacin</td>
<td>7.5mg/kg BD (max 750mg BD)</td>
<td>7.5mg/kg OD*</td>
<td>7.5mg/kg OD*</td>
<td>2mg/kg OD 100% renally cleared and accumulates rapidly if filtration interrupted in anuric patients. Check levels</td>
<td>Yes</td>
<td>Nephrotoxic and ototoxic in high levels. Levels sent to Bristol for analysis. Sample to the lab by 2pm for next day lunchtime reporting Mon-Fri. Levels taken at weekends will be reported for the following Tuesday. Require pre-dose and 1 hour post dose – 24 hours after starting treatment. *A few references refer to giving an initial loading dose of 10mg/kg during RRT</td>
</tr>
<tr>
<td>Amoxicillin (Normal Dose)</td>
<td>1g TDS</td>
<td>As normal renal function</td>
<td>As normal renal function</td>
<td>As normal renal function</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Amoxicillin (High Dose)</td>
<td>2g 4hourly (listeria meningitis/endocarditis)</td>
<td>As normal renal function. Review daily</td>
<td>As normal renal function. Review daily</td>
<td>1g 4hourly</td>
<td>Yes</td>
<td>No specific information relating to high dose therapy. Risk of convulsions and crystalluria in anuric patients.</td>
</tr>
<tr>
<td>Anidulafungin</td>
<td>Day 1 loading dose 200mg daily then 100mg daily</td>
<td>As normal renal function</td>
<td>As normal renal function</td>
<td>As normal renal function</td>
<td>No</td>
<td></td>
</tr>
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<td>Notes</td>
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</tr>
<tr>
<td>Benzylpenicillin (Normal Dose)</td>
<td>1.2g - 2.4g QDS</td>
<td>1.8g - 2.4g QDS</td>
<td>1.8g-2.4g QDS</td>
<td>600mg-1.2g QDS</td>
<td>Yes</td>
<td>Convulsions associated with drug accumulation. If seizures occur, consider whether this drug may be implicated.</td>
</tr>
<tr>
<td>Benzylpenicillin (High Dose)</td>
<td>2.4g 4hourly</td>
<td>1.2g – 1.8g 4 hourly</td>
<td>1.8g - 2.4g 4 hourly</td>
<td>600mg – 1.2g QDS</td>
<td>Yes</td>
<td>Convulsions/ cerebral irritation particularly associated with accumulation in high dose therapy. If seizures occur, consider whether this drug may be implicated. NUH experience of average sized patients tolerating 1.8g 4 hourly on CVVH. UKCPA discussion 2016 in critically unwell consider leaving 2.4g 4 hourly for 1st 24 hours before reducing.</td>
</tr>
<tr>
<td>Caspofungin</td>
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<td>No</td>
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<tr>
<td>Loading Dose:</td>
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<td></td>
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<tr>
<td>70mg</td>
<td></td>
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<tr>
<td>Maintenance Dose:</td>
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<tr>
<td>35- 50mg OD</td>
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<tr>
<td>(70mg if weight &gt;80kg)</td>
<td></td>
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</tr>
<tr>
<td>Ceftriaxone</td>
<td>2g BD or 2g OD</td>
<td></td>
<td></td>
<td></td>
<td>Maximum 2g daily</td>
<td>Unknown</td>
</tr>
<tr>
<td>Drug Name</td>
<td>Dosage in Normal Renal Function</td>
<td>Dosage during CVVH</td>
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</tr>
<tr>
<td>Cefuroxime</td>
<td>1.5g TDS 24-48 hours then review</td>
<td>1.5g TDS 24-48 hours then review</td>
<td>1.5g BD</td>
<td>1.5g BD</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Ciprofloxacin</td>
<td>400mg BD</td>
<td>As normal renal function</td>
<td>As normal renal function</td>
<td>200mg BD</td>
<td>Yes</td>
<td>Potential for lowered seizure threshold. If seizures occur this drug should be considered.</td>
</tr>
<tr>
<td>Clarithromycin</td>
<td>500mg BD</td>
<td>As normal renal function</td>
<td>As normal renal function</td>
<td>As normal renal function</td>
<td>Unknown</td>
<td></td>
</tr>
<tr>
<td>Clindamycin</td>
<td>600mg – 1200mg QDS</td>
<td>As normal renal function</td>
<td>As normal renal function</td>
<td>As normal renal function</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Co-amoxiclav</td>
<td>1.2g TDS</td>
<td>1.2g TDS for 24-48 hours then review</td>
<td>1.2g TDS for 24-48 hours then review</td>
<td>1.2g BD</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Cotrimoxazole (Normal dose)</td>
<td>960- 1440mg BD</td>
<td>As normal renal function</td>
<td>As normal renal function</td>
<td>As normal renal function</td>
<td>Yes</td>
<td>Reference quote 50% of normal dose in RRT. However if critically ill advisable to leave at normal dose.</td>
</tr>
<tr>
<td>Cotrimoxazole (PCP treatment)</td>
<td>120mg/kg/day in 2 to 4 divided doses</td>
<td>As normal renal function for three days then 30mg/kg BD</td>
<td>As normal renal function for three days then 30mg/kg BD</td>
<td>30mg/kg BD</td>
<td>Yes</td>
<td>Pre and post dose levels can be sent to Bristol if clinically indicated. Discuss with micro first.</td>
</tr>
<tr>
<td>Drug Name</td>
<td>Dosage in Normal Renal Function</td>
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<td>Dosage during CVVHDF</td>
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</tr>
<tr>
<td>Daptomycin</td>
<td>4-6mg/kg OD (micro can recommend up to 8mg/kg for endocarditis /joints)</td>
<td>4-6mg/kg daily (8mg/kg 48 hourly)</td>
<td>4-6mg/kg daily (8mg/kg 48 hourly)</td>
<td>4mg/kg every 48 hours</td>
<td>Unknown</td>
<td>Trough levels can be measured by Bristol. VD altered in severe sepsis aim for higher troughs. Monitor CK levels every 2-3 days increased risk of dose dependent myopathy and rare rhabdomyolysis in renal impairment.</td>
</tr>
<tr>
<td>Flucloxacillin (Normal dose)</td>
<td>1g – 2g QDS</td>
<td>As normal renal function</td>
<td>As normal renal function</td>
<td>1g QDS</td>
<td>No</td>
<td>Increased risk of nephro and neurotoxicity with high doses. If signs of neurotoxicity then consider reducing dose to 2g QDS</td>
</tr>
<tr>
<td>Flucloxacillin (High dose)</td>
<td>2g 4 hourly</td>
<td>2g 4 hourly for the first 24 hours then review</td>
<td>2g 4 hourly for the first 24 hours then review</td>
<td>1g QDS</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Fluconazole</td>
<td>Loading dose of 800mg depending on indication for use. 200-400mg OD</td>
<td>As normal renal function</td>
<td>As normal renal function</td>
<td>200mg OD</td>
<td>Yes</td>
<td>Clearance by CVVH and CVVHDF in renal insufficiency is significant and could be ≥ that of a patient with normal renal function.</td>
</tr>
<tr>
<td>Flucytosine</td>
<td>50mg /kg QDS</td>
<td>50mg/kg daily</td>
<td>50mg /kg daily</td>
<td>1g daily until filter restarted or CrCL &gt; 10ml/min</td>
<td>Yes</td>
<td>Monitor pre and one hour post dose levels. Sent to Bristol Mon-Friday 48 hours after starting treatment take approximately two working days for results.</td>
</tr>
<tr>
<td>Drug Name</td>
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</tr>
<tr>
<td>Foscarnet</td>
<td>Dosing according to individualised renal function. Frequency many vary from manufacturers guidance.</td>
<td>Discuss with critical care pharmacist</td>
<td>Discuss with critical care pharmacist</td>
<td>Discuss with haematology regarding holding treatment</td>
<td>Yes</td>
<td>CRRT summary sheet available on pharmacist network site. Produced by NUH from in house experience 2016. Drug nephrotoxic</td>
</tr>
<tr>
<td>Ganciclovir</td>
<td>Induction 5mg/kg BD Maintenance 5mg/kg OD</td>
<td>2.5mg/kg OD</td>
<td>2.5mg/kg OD</td>
<td>1.25mg/kg OD</td>
<td>Yes</td>
<td>Monitor closely for myelosuppression. Pre and post dose levels can be sent to Bristol if clinically indicated.</td>
</tr>
<tr>
<td>Gentamicin (Once daily)</td>
<td>5mg/kg OD</td>
<td>3mg/kg. Check levels daily and re-dose when trough levels less than 1mg/L</td>
<td>3-5mg/kg. Check levels daily and re-dose when trough levels less than 1mg/L</td>
<td>2mg/kg. Check levels daily and re-dose when trough levels less than 1mg/L</td>
<td>Yes</td>
<td>100% renally cleared and accumulates rapidly if filtration interrupted in anuric patients. Nephrotoxic and ototoxic in high levels. Await levels daily prior to dosing to be taken at least 18 hours post dose.</td>
</tr>
<tr>
<td>Levofloxacin</td>
<td>500mg OD or BD</td>
<td>500mg LOAD then 250mg OD</td>
<td>500mg LOAD then 250mg OD</td>
<td>125mg OD</td>
<td>Yes</td>
<td>One paper suggests giving 250mg dose in CRRT is equivalent to 500mg in normal renal function</td>
</tr>
<tr>
<td>Linezolid</td>
<td>600mg BD</td>
<td>As normal renal function</td>
<td>As normal renal function</td>
<td>As normal renal function</td>
<td>Yes</td>
<td>Two inactive metabolites accumulate in renal failure which have MAOI activity. Monitor FBC and for neuropathic side effects.</td>
</tr>
<tr>
<td>Drug Name</td>
<td>Dosage in Normal Renal Function</td>
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<td>Dosage during CVVHDF</td>
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<tr>
<td><strong>Meropenem</strong></td>
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</tr>
<tr>
<td><em>(Normal dose)</em></td>
<td>1g TDS or 500mg QDS</td>
<td>1g BD</td>
<td>1g BD (see in house experience of leaving TDS) or 500mg QDS</td>
<td>1g OD or 500mg BD</td>
<td>Yes</td>
<td>If clinically indicated NUH experience of continuing 1g TDS. Seizures can occur upon accumulation but this is rarer than for other penicilins. If seizures occur, consider if this drug is implicated.</td>
</tr>
<tr>
<td><em>(High dose)</em></td>
<td>2g TDS (or 1g TDS)</td>
<td>2g BD</td>
<td>2g BD (or 1g TDS)</td>
<td>1g OD</td>
<td>Yes</td>
<td>Indicated by microbiology for CNS / deep seated infections or Necrotising fasciitis. For life threatening infections consider giving 2g TDS for 1st 24 hours as a load. Dosing based on NUH experience.</td>
</tr>
<tr>
<td><strong>Metronidazole</strong></td>
<td>500mg TDS</td>
<td>As normal renal function</td>
<td>As normal renal function</td>
<td>As normal renal function</td>
<td></td>
<td>Unknown</td>
</tr>
<tr>
<td><strong>Micafungin</strong></td>
<td>100mg OD &lt;40kg 2mg/kg</td>
<td>As normal renal function</td>
<td>As normal renal function</td>
<td>As normal renal function</td>
<td></td>
<td>No</td>
</tr>
<tr>
<td><strong>Moxifloxacin</strong></td>
<td>400mg OD</td>
<td>As normal renal function</td>
<td>As normal renal function</td>
<td>As normal renal function</td>
<td></td>
<td>Unknown</td>
</tr>
<tr>
<td><strong>Ofloxacin</strong></td>
<td>200-400mg BD</td>
<td>200 - 400mg OD</td>
<td>200mg-400mg OD</td>
<td>100-200mg daily</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Drug Name</td>
<td>Dosage in Normal Renal Function</td>
<td>Dosage during CVVH</td>
<td>Dosage during CVVHDF</td>
<td>Action taken in CVVH interrupted for &gt;4-6 hours where Urine Output &lt;10ml/hr</td>
<td>Removal of drug by CRRT</td>
<td>Notes</td>
</tr>
<tr>
<td>-------------------</td>
<td>--------------------------------</td>
<td>--------------------</td>
<td>----------------------</td>
<td>--------------------------------------------------------------------------------</td>
<td>--------------------------</td>
<td>----------------------------------------------------------------------</td>
</tr>
<tr>
<td>Oseltamivir</td>
<td>75mg BD Treatment dose</td>
<td>75mg daily</td>
<td>75mg daily</td>
<td>30mg daily</td>
<td>Yes</td>
<td>Double dosing in critically ill patients no longer indicated in PHE guidance 2015/16. PHE recommend 30mg BD but local Network practice is to use 75mg OD</td>
</tr>
<tr>
<td>Piperacillin/tazobactam (Tazocin)</td>
<td>4.5g TDS (Derby: 4.5g QDS)</td>
<td>4.5g TDS</td>
<td>4.5g TDS</td>
<td>4.5g BD</td>
<td>Yes</td>
<td>Patients at greater risk of convulsions in renal failure associated with accumulation</td>
</tr>
<tr>
<td>Rifampicin</td>
<td>600mg – 1200mg in 2-4 divided doses</td>
<td>As normal renal function</td>
<td>As normal renal function</td>
<td>As normal renal function</td>
<td>Unknown</td>
<td>For severe infections levels of 15-20mg/L are sometimes recommended by microbiology. NUH have a vancomycin calculator on the antibiotic website. Not suitable for patients of CRRT or AKI.</td>
</tr>
<tr>
<td>Vancomycin (Intermittent Infusion)</td>
<td>Weight based LOADING dose followed by a maintenance dose at least 12 hours later. Dosing daily to Three times a day according to renal function</td>
<td>Normal LOADING dose. Check level 24 hours after the load prior to giving any further doses. Starting dose 500mg BD. Check levels at 12 hourly intervals and dose accordingly</td>
<td>Normal LOADING dose. Check level 24 hours after the load prior to giving any further doses. Starting dose 500mg BD. Check levels at 12 hourly intervals and dose accordingly</td>
<td>100% renally cleared. Accumulates rapidly if filtration interrupted in anuric patients. Do not give any further doses until a trough level checked at least 12 hours post dose. Check subsequent</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Drug Name</td>
<td>Dosage in Normal Renal Function</td>
<td>Dosage during CVVH</td>
<td>Dosage during CVVHDF</td>
<td>Action taken in CVVH interrupted for &gt;4-6 hours where Urine Output &lt;10ml/hr</td>
<td>Removal of drug by CRRT</td>
<td>Notes</td>
</tr>
<tr>
<td>------------</td>
<td>---------------------------------</td>
<td>--------------------</td>
<td>----------------------</td>
<td>---------------------------------------------------------------------------</td>
<td>----------------------------</td>
<td>-------------------------------------------------------------------</td>
</tr>
</tbody>
</table>

**Filtration Machine (Company Name)**
- Aquarius (Edwards)
- Prisma (Gambro)
- Infomed (Informed)

**Ultrafiltrate Rate**
35ml/kg/hr (up to 45ml/kg/hr)

**Use of Pre/Post-Dilution Blood**
Yes (Approx. 1/3pre and 2/3post)

---

This information is only intended as a practical guide to dosing using the above filtration methods. Clinical guidelines are guidelines only. The interpretation and application of the clinical guidelines to individual patients will remain the responsibility of the individual clinician. If in doubt contact a senior colleague or expert.

References for specific entries are available on request email Elizabeth.jamieson@nuh.nhs.uk
Guideline for the Detection and Management of Delirium in Adult Critical Care

Introduction:
Delirium is a common state in Critical Care and has far reaching consequences. It is associated with increased length of stay in Critical Care and hospital, increased 6 month mortality, morbidity and a decrease in IQ. It can often be prevented or treated when identified, but vigilance is needed.

Delirium is “an acute, reversible organic mental syndrome with disorders of attention and cognitive function, increased or decreased psychomotor activity and a disordered sleep-wake cycle”. The incidence has been quoted as 15-80% in critically ill patients.

Types:
Three types of delirium have been identified:
- Hypo-active – withdrawn and paranoid:
- Hyperactive – agitated, paranoid, visual hallucinations
- Mixed delirium – mixed signs and symptoms.
  - Hypo-active delirium is often undiagnosed as these patients are withdrawn and compliant. It also carries a worse outcome, possibly because of delayed or missed diagnosis.

Traumatic brain injury (TBI):
Patients who have suffered TBI have a higher chance of developing delirium. This is due to the physical injury to the brain combined with polypharmacy and temperature fluctuations (often iatrogenic). The management principles of delirium in these patients are broadly speaking the same with the exception of minimizing haloperidol use, hence the separate treatment arm. There is evidence to suggest haloperidol can delay neuronal recovery and hence clinical recovery. Atypical antipsychotics and valproate have been shown to be safer and effective.

Note: Quetiapine clearance is significantly increased by phenytoin (in the order of 450%) and carbamazepine. Olanzapine is preferred in this situation.

Predisposing factors to delirium:
- Failure to provide adequate pain relief
- Sleep deprivation / altered sleep pattern or loss of night and daytime routine
- History of mental illness
- Hypoxaemia
- Acidosis
- Severe infection (sepsis)
- Advancing age - > 65 years old especially at risk
- Immobilisation - (Neck of femur fracture much increased risk)
- Frustration
- Patient-ventilator asynchrony
- Metabolic and haemodynamic instability, dehydration, constipation
- Cerebral illnesses (e.g. Alzheimer’s, dementia, stroke, abscesses, seizures, tumours)
- Drug interactions
- Withdrawal of drugs (opioids, benzodiazepines) or
- Pre-existing alcohol/substance abuse.
Figure 1: RISK FACTORS FOR DELIRIUM

**Patient Characteristics:**
- Age
- Alcohol
- Gender
- Living single at home
- Smoking

**Environment:**
- Admission via ED
- Admission via transfer
- Isolation
- No clock
- No visible daylight
- No visit
- Open intensive care
- Physical restraint

**Chronic Pathology:**
- Predisposing -
  - Cardiac disease
  - Cognitive impairment
    - Including mental illness
  - Pulmonary disease

**Acute Illness:**
- Length of stay
- Fever
- High risk of mortality
- Medical admission
- No enteral feed
- Blood transfusions
- Psychoactive medication
- Sedation
- TISS > 28

Figure 2: IDENTIFICATION AND TREATMENT OF DELIRIUM

**Screen for Delirium 12 hrly at handover**

If on delirium treatment need to be CAM-ICU neg twice before stopping drugs. If drugs used for 7 days or longer, wean over 2-3 days.

**CAM-ICU**

If still CAM-ICU positive in 12hrs or harm imminent start pharmacological treatment Figure 4

**Delirium**

Implement non-pharmacological interventions

(5) - Differential diagnosis
- D: Drugs, Drugs, Drugs (consider withdrawal of drug)
- E: Eyes, ears
- L: Low O2 states (MI, ARDS, PE, CHF, COPD)
- I: Infection
- R: Retention (of urine or stool), Restraints
- I: Ictal (seizures)
- U: Underhydration/Undernutrition (Deficiencies)
- M: Metabolic (Endocrinopathy)
- (S): Subdural (Trauma), Sleep deprivation
Figure 3: IDENTIFICATION AND TREATMENT OF DELIRIUM – CAM ICU

Figure 4: PHARMACOLOGICAL TREATMENT OF DELIRIUM

All prescriptions should be endorsed: **Critical Care Delirium – review prior to discharge from Critical Care.** This is to avoid inappropriate continuation of therapy.
Figure 5: SLEEP BUNDLE

Assess and manage pain and anxiety as per pain and sedation guideline

Yes

Delirium

No

All prescriptions should be endorsed: *Short term sleep aid review prior to discharge from Critical Care.* This is to avoid inappropriate continuation of therapy

Make sure the sleep bundle has been adhered to; appendix 1

Mirtazapine

Mirtazapine

Melatonin

Melatonin

Trazodone

Trazodone

Zopiclone

Zopiclone
Figure 6: MANAGEMENT OF THE SEVERELY AGITATED PATIENT WITHOUT MENTAL CAPACITY

Ensure safety of staff and other patients
Attempt to calm patient by talking
Try and keep or establish IV access/oxygen/monitoring

Is rapid intervention needed?

Advanced airway skills immediately available?

Yes
Midazolam 2.5-5mg IM or IV or Lorazepam 2mg IM or IV, extreme cases will need anaesthetic agents and intubation.

No

Haloperidol 1.25 – 5 mg IM/IV

Adequate sedation achieved?

Yes
Establish full monitoring
Give oxygen
ECG to check QT interval
Assess patient for reason of severe agitation:
Differential diagnosis of delirium

No

Consider oral Lorazepam/Quettapine/Olanzapine

Call police or security if patient violent or threatening

No

Ensure anaesthetic cover

Bibliography:
1. Detection, Prevention and Treatment of Delirium in Critically Ill Patients. UKCPA, ICS, 2006
2. Delirium: diagnosis, prevention and management, NICE clinical guideline 103
5. Delirium guideline Manchester ICU.


12. Guys and St Thomas Hospital Clonidine Guidelines. Electronic communication with the UKCPA Critical Care Group.


18. NEWT guideline http://www.newtguidelines.com/

19. BNF electronic link http://www.bnf.org/bnf/


25. CAM-ICU demonstration - https://youtu.be/6WyJ0zL7Vkl


36. CAM-ICU demonstration - https://youtu.be/6WyJ0zL7Vkl


42. Bourne R, Mills G, Minelli C. Melatonin therapy to improve nocturnal sleep in critically ill patients: encouraging results from a small randomised controlled trial. *Critical Care* 2008: R52. Available at http://ccforum.com/content/12/2/R52
Appendix 1: Delirium and sleep bundle.

Noise:
- Turn monitoring equipment to night mode between 22:30 and 07:00
- Reduce volumes on all telephones between 22:30 and 07:00
- No non-clinical discussions around patients’ bed spaces
- Staff and visitors to speak quietly
- Offer earplugs to all patients with Richmond Agitation Sedation Scale score greater than – 4

Light:
- Dim main ICU lights between 22:30 and 07:00
- Use bedside lighting for patient care
- Offer eye masks to all patients with Richmond Agitation Sedation Scale score greater than -4

Patient care:
- Cluster care/procedures where possible.
- Complete care procedures before 22:30 or delay their completion until after 08:00 where possible- i.e. no vent tubing change/pressure line changes until 8:00.
- Consider 4 hourly turns overnight in patients who are on 2 hourly turns during the day, with accompanying documentation.
- Orientate patients regarding time, place and date every eight hours
- If the patient normally wears glasses, hearing aids and / or false teeth, make sure aids are available to use.
- Use of typing boards to improve communication should be considered.
- If patients sleep poorly or have a positive result on the CAM-ICU, perform a medication review within 24 h
- Set appropriate sedation targets once per day (based on the Richmond Agitation Sedation Scale) and titrate sedation accordingly
- All patients requiring mechanical ventilation of the lungs to be assessed daily for suitability for sedation hold between 8:00-10:00 or trials of spontaneous breathing as per ABCDE protocol
- Hourly pain scores and prompt action to optimize analgesia
- Ensure early mobilization when possible and appropriate
- Maintain activity levels: non-ambulatory patients should undergo a full range of movements for at least 15 minutes, three times a day if possible.
- Discourage daytime sleeping, but use the rest period for those patients that are very tired.
- If all the above has been done and still the patient cannot sleep, then start sleep medication – Figure 6.
Appendix 2: Drugs

Clonidine

Background and therapeutic Indication

Clonidine is an adrenergic agonist that activates central inhibitory alpha 2 receptors reducing catecholamine release. It exhibits sedative and analgesic properties. It may be useful for agitation and delirium, difficult to manage by first line agents. Clonidine is effective in reducing some of the withdrawal symptoms of opioids, alcohol and nicotine.

For this reason, it may also be considered an aid to weaning from conventional opiate sedation when agitation and withdrawal are problematic.

Contraindications:

- Severe brady-arrhythmias resulting from sick sinus syndrome or AV block of 2nd and 3rd degree.
- Hypotension , patients requiring inotropic support

Cautions:

- Cerebrovascular or coronary insufficiency (recent ACS)
- Mild to moderate brady-arrhythmia
- Heart failure.
- Renal impairment .Clearance is reduced. Due to its long half-life between 6-20 hours in normal renal function, which may double in acute renal failure, accumulation occurs slowly and may produce unpredictable bradycardia. Review dose at regular intervals. Aim to keep as low as possible

Dosage:

IV Continuous Infusion via a syringe:

750 micrograms (5 ampoules) made up to a total volume of 50ml sodium chloride 0.9% (15micrograms/ ml) administered via the central or peripheral route

Usual dosage range 1 to 2 mcg /kg/hour.

Dependent on the level of agitation the dose may start at 2mcg/kg/hour to effectively provide a loading dose due to its long half-life, then reduce after one hour as the sedative effective is achieved. Alternatively start at 1ml/hr titrated upwards with suggested increments of 0.5 -1ml /hr.

Regularly review the infusion rate titrating to the minimum effective dose .The need for a continuous IV infusion should be reviewed in all patients every 24 - 48 hours.

Notes:

- Where possible (and side effects do not dictate) do not stop infusion abruptly, withdraw slowly over a few hours. Sudden withdrawal may result in agitation, tachycardia, sweating and hypertension. If received treatment (particularly high dose) for more than 3-4 days then wean dose slowly over 24-72 hours
Dosage administration chart: 750 micrograms in 50ml = 15 micrograms/ml

<table>
<thead>
<tr>
<th>Patient weight (kg)</th>
<th>1 mcg/kg/hour</th>
<th>2 mcg/kg/hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>3.3 ml/hr</td>
<td>6.7 ml/hr</td>
</tr>
<tr>
<td>55</td>
<td>3.7 ml/hr</td>
<td>7.3 ml/hr</td>
</tr>
<tr>
<td>60</td>
<td>4.0 ml/hr</td>
<td>8.0 ml/hr</td>
</tr>
<tr>
<td>65</td>
<td>4.3 ml/hr</td>
<td>8.7 ml/hr</td>
</tr>
<tr>
<td>70</td>
<td>4.7 ml/hr</td>
<td>9.3 ml/hr</td>
</tr>
<tr>
<td>75</td>
<td>5.0 ml/hr</td>
<td>10.0 ml/hr</td>
</tr>
<tr>
<td>80</td>
<td>5.3 ml/hr</td>
<td>10.7 ml/hr</td>
</tr>
<tr>
<td>85</td>
<td>5.7 ml/hr</td>
<td>11.3 ml/hr</td>
</tr>
<tr>
<td>90</td>
<td>6.0 ml/hr</td>
<td>12.0 ml/hr</td>
</tr>
<tr>
<td>95</td>
<td>6.3 ml/hr</td>
<td>12.7 ml/hr</td>
</tr>
<tr>
<td>100</td>
<td>6.7 ml/hr</td>
<td>13.3 ml/hr</td>
</tr>
<tr>
<td>105</td>
<td>7.0 ml/hr</td>
<td>14.0 ml/hr</td>
</tr>
<tr>
<td>110</td>
<td>7.3 ml/hr</td>
<td>14.7 ml/hr</td>
</tr>
</tbody>
</table>

Enteral administration:

Clonidine is very well absorbed with bioavailability of 75 to 100%. Consider starting doses of 100- 150 micrograms four times a day increasing dose or frequency of administration as appropriate. Higher doses of 1000 micrograms over 24 hours (150mcg four hourly) has been used but consider administration via a continuous infusion if this is indicated.

Presentation and administration

Intravenous injection: 150 micrograms per ml
Tablets 25 and 100 micrograms

Enteral feeding tubes

The injection may be administered via enteral feeding tubes given neat or diluted with water prior to administration.

Side effects:

- Bradycardia and hypotension are common at higher doses, particularly after prolonged therapy.
- Tolerance /tachyphylaxis develop within 7 days of starting therapy.
- Acute colonic obstruction has been reported in high doses.
- May cause a small rise in blood glucose.
- Hypotension, Sinus bradycardia, AV block.
- Convulsions have been reported in overdose and in renal failure patients

Rapid administration may cause transient hypertension and rebound hypotension.
Haloperidol

**Background and therapeutic indication**

Haloperidol is a 'typical' antipsychotic with predominantly dopamine antagonist activity.

Due to an increased risk of QT prolongation with the IV route haloperidol is now ONLY licensed for oral and IM use. Within critical care a local agreement exists (page ....) to enable nurses to continue to give haloperidol via the IV route.

For place in therapy refer to the pharmacological treatment of delirium flow chart: Pharmacological treatment of delirium

**Contra-indications**

Parkinson's disease, bradycardia, patients with pre-existing QT interval prolongation or with clinically significant cardiac disorders e.g. recent acute myocardial infarction, uncompensated heart failure, arrhythmias treated with class I A and III antiarrhythmic medicinal products e.g. amiodarone.

**Cautions**

Risk of QT prolongation is greatest with IV administration. Ensure all electrolytes are corrected prior to initiating treatment. Continuous ECG monitoring is required during IV treatment. Reduce dose if QTC prolonged >450msec or 25% greater than previous ECG readings. Therapy MUST be discontinued if QTc>500msec.

Uncontrolled seizures. Haloperidol can lower seizure threshold. Start with lower doses.

Haloperidol should preferably not be used concomitantly with other QT prolonging drugs especially if multiple combinations are prescribed. Commonly prescribed drugs in critical care associated with QT prolongation include: amiodarone, sotalol, metoclopramide, methadone, ciprofloxacin, erythromycin (IV antibiotic doses) and clarithromycin. Fluconazole and voriconazole can increase haloperidol levels.

**Dose**

Initial regular dose 5-20mg in divided doses (e.g. 1.25 - 5mg IV 6 hourly). The initial dose is dependent on the age of the patient, degree of hepatic dysfunction and the severity of the hyperactive delirium symptoms. Additional as required doses are normally in the range of 1.25mg-2.5mg. The enteral route may be used for less disturbed patients identified through early delirium scoring.

The oral bioavailability of haloperidol is only 60% therefore the IV/IM and oral doses are not equivalent. Prescriptions MUST NOT be accepted for Haloperidol written as 2.5mg IV/NG.

If the patient remains unmanageable 20-30 minutes after an intravenous dose and is not exhibiting undesirable side effects, double the haloperidol dose. This cycle should be repeated until the patient is manageable, then give regular haloperidol, usually at a smaller dose regularly in divided doses than the initial control dose.
There has been no daily maximum safe dose of haloperidol established. Exceptionally large doses have been reported, but QT prolongation may occur. Such high doses may only increase toxicity without efficacy. For doses above 20mg daily consider switching to a regular atypical antipsychotic.

Regular haloperidol should be reviewed daily for efficacy and adverse effects. Once delirium symptoms resolve it may be withdrawn over 2-3 days withdrawing the daytime doses first.

**Hypoactive delirium**

Use low dose Haloperidol 500micrograms IV three times a day

**Presentation and administration**

**Intramuscular (Intravenous) injection**

5mg / ml ampoules

**Enteral feeding tubes**

Oral liquid 2mg/ml

**Undesirable effects of Haloperidol**

Extrapyramidal symptoms (tremor, rigidity, restlessness, hyper-salivation) discontinue treatment. Consider Procyclidine therapy but this may worsen delirium symptoms.

Neuroleptic malignant syndrome. (Hyperthermia, generalised muscle rigidity, autonomic instability, altered consciousness, coma and elevated CPK) is a MEDICAL emergency requiring prompt treatment.
**Atypical antipsychotics**

*(Quetiapine, Olanzapine and Risperidone)*

As a class effect still have the rare potential (at the doses used to manage delirium) to cause QT prolongation and must be used with caution in patients with known cardiovascular disease e.g. myocardial infarction or concomittant drugs known to cause QT prolongation. (see common list under haloperidol)

Due to their pharmacology the incidence of extra-pyramidal side effects appears lower with this class of antipsychotic.

They all have the potential to lower the seizure threshold and should be used with caution in patients with a history of seizures. Note: Quetiapine clearance is significantly increased by phenytoin (in the order of 450%) and carbamazepine. Olanzapine is preferred in this situation.

**Olanzapine**

**Back ground and therapeutic Indications**

Olanzapine is an atypical” antipsychotic. It has greater anti-serotonin (5HT) versus dopamine activity.

For place in therapy refer to the pharmacological treatment of delirium flow chart: Pharmacological treatment of delirium

It use in the management of delirium has not shown to be superior to haloperidol but may be a useful alternative in patients in whom haloperidol is contra-indicated or are intolerant of side effects.

**Cautions**

May worsen symptoms of Parkinson’s disease particularly at higher doses. Clonidine and olanzapine co-administration may increase the risk of postural hypotension.

**Dose**

Oral doses of 2.5 – 15 mg have been used in delirium studies. Doses greater than 5 mg daily have no extra anti-serotonin activity, but do increase dopamine antagonism and therefore increase the risk of extrapyramidal side effects.

Commence at 5 to 10 mg once daily at night due to its sedative effects. However consider using a lower starting dose 2.5 – 5 mg in patients receiving GABAminergic drugs i.e. benzodiazepines or propofol, patients > 60 years and those with significant renal and/ or hepatic dysfunction.

Maximum daily dose is 20mg.

Haloperidol may be used concomitantly when required as a rescue intervention.
Presentation and administration

Enteral feeding tubes

Use olanzapine oro-dispersible tablets 5 mg or 10 mg. For a 2.5mg dose, dissolve 5mg tablet in 10ml sterile water for irrigation and administer 5 ml of the resulting solution.

Undesirable effects

Sedation, postural hypotension, bradycardia. Rarely reported hyperglycaemia, extrapyramidal side effects and neuroleptic malignant syndrome

Risperidone

Background and therapeutic Indication

Risperidone is an “atypical antipsychotic”. It has greater anti-serotonin versus dopamine activity.

Risperidone also has alpha-2 antagonist properties.

Risperidone is reserved for the treatment of hypoactive delirium and in higher doses for refractory hyperactive and mixed delirium. For place in therapy refer to figure 4.

Caution

Elderly patients (>65yrs) with risk factors for a stroke

Dose

Hypo active delirium 500 micrograms twice a day. In severe hepatic or renal impairment use 50% of the dose

Preparation and administration

Enteral feeding tubes

Risperidone orodispersible tablets dispersed in water and administered via the feeding tube

Alternatively risperidone syrup 5mg in 5ml is available 100ml bottles.

Undesirable effects

Headache, blurred vision, drowsiness. Neuroleptic malignant syndrome
Quetiapine

Background and therapeutic Indication

Quetiapine and its active metabolite (norquetiapine) is an “atypical antipsychotic”. It has greater anti-serotonin versus dopamine activity. Quetiapine and norquetipaine have minimal anticholinergic activity.

Quetiapine also has histamine and alpha1 antagonist properties.

Persistent QT interval prolongation is rarely associated with doses used in the management of delirium.

For place in therapy refer to the pharmacological treatment of delirium flow chart: figure 4

Contra-indications

As Quetiapine is metabolized by the cytochrome P450 3A4 isoenzyme its use must be avoided with others drugs that inhibit this enzyme. Drugs in this class commonly used in critical care include: Fluconazole, Voriconazole, Erythromycin (antibiotic dose) and Clarithromycin.

Cautions

Use in combination with cytochrome P450 enzyme inducers (e.g. carbamazepine and phenytoin) due to reduced efficacy of Quetiapine. The use of Olanzapine would be preferred in this patient group.

Patients admitted with a primary neurological disorder.

Dose

The usual starting dose is 25-50mg twice a day. In one small study a starting dose of 50mg twice a day was used and the titrated up daily by increments of 50mg every 12 hours to a maximum of 200mg every 12 hours.

Haloperidol may be used concomittantly when required as a rescue intervention.

In older patients and those with hepatic impairment start with lower doses e.g. 12.5mg twice a day.

No dose adjustment is required in renal impairment.

Preparation and administration

Enteral feeding tubes

Available as 25mg and 100mg film coated tablets may be crushed and mixed with water before administration. Flush well after administration. Do not use modified release tablets.

Undesirable effects

Commonly drowsiness, dizziness, headache, tachycardia, orthostatic hypotension (especially during dose titration). Rarely extra pyramidal symptoms, hyperglycaemia and neuroleptic malignant syndrome.
Sodium Valproate

Therapeutic Indications
In patients recovering from TBI, there are limited data supporting the efficacy of sodium valproate in the treatment of severe agitation and disinhibition. Unlike phenytoin, sodium valproate does not appear to adversely affect cognitive recovery in TBI patients. The use for this indication is unlicensed.

Cautions
Avoid in severe hepatic dysfunction.

Dose: Initially 250-500mg BD orally or IV, titrating gradually every 3 days

Presentation and administration

Intravenous injection
400mg injection

Enteral feeding tubes
Liquid 200mg/5ml

Cautions: Avoid in severe hepatic dysfunction.

Adverse effects
GI intolerance, hyperammonaemia, thrombocytopenia; rarely - hepatic toxicity, pancreatitis

Trazodone

Therapeutic indication:
Trazodone is a tricyclic related anti-depressant with sedative side-effects. It can be used off-licence as a short term sleep aid in patients at risk of delirium or who are already delirious. Trazodone exhibits 5-HT2 antagonism, minimal anti-muscarinic activity and reduced adverse effects on the normal sleep cycle in healthy adults.

Contra-indications:
Arrhythmias, particularly heart block. The immediate recovery period following MI.

Cautions:
Elderly patients are particularly susceptible to experiencing side effects

Dose: Starting dose is 50-100mg at night. Can be increased to maximum 150mg at night. Tolerance develops to sedative effects.

Side-effects: Priapism- discontinue immediately.

Enteral administration (Enteral feeding tubes)
50mg capsules open and disperse in water
**Zopiclone**

**Therapeutic indications:**

Zopiclone is a non-benzodiazepine hypnotic that acts on the benzodiazepine receptor. It can be used short term for the treatment of insomnia who are delirium negative on scoring. It is not licensed for long-term (longer than 4 weeks) use.

**Contra-indication:**

Severe sleep apnoea syndrome, marked neuromuscular respiratory weakness including unstable myasthenia gravis

**Cautions:** Myasthenia gravis, elderly patients, psychiatric illness.

**Dose:** Oral dose is 3.75-7.5mg at night, start with 3.75mg in elderly patients or in those with severe renal impairment. Use the lowest effective dose.

*(Have used up to 15mg as Stat increased risk of delirium)*

**Undesirable effects:**

Nausea and vomiting, dizziness, headaches. Rarely confusion and hallucinations.

**Enteral administration (Enteral feeding tubes):**

Film coated tablets can be crushed and dispersed in water for administration via enteral feeding tubes.

**Mirtazapine**

**Therapeutic indications:**

Is a tetracyclic antidepressant specifically antagonising alpha 2 adrenergic, as well as 5HT2 and 5HT3 receptors. It has anxiolytic and sedative properties but without significant antimuscarinic activity. The use as a short term sleep aid is an off-licence indication.

**Cautions:**

Potential rare risk of prolonged QTc. Caution co-administering with other drugs that prolong QTc.

CYP34A inducers such as carbamazepine, phenytoin, rifampicin can increase the clearance of mirtazapine approximately two-fold. Consider the need to increase the dose to 30mg or use Trazodone.

CYP34A inhibitors such as fluconazole, voriconazole and erythromycin can reduce the clearance of mirtazapine.

**Dose:** 15mg at night

**Side effects:** Headache, Dry mouth, rare paradoxical agitation.

**Enteral administration (Enteral feeding tubes):**

15mg oro-dispersible tablet. Disperse in water for enteral administration
Melatonin

**Therapeutic indication:**
Melatonin a pineal hormone with known sedative properties, that maintains sleep regulation and the circadian rhythm. Critically ill patients exhibit reduced melatonin secretion.

**Cautions:**
Hepatic impairment clearance reduced. Avoid.
No information on use in renal impairment. Use with caution

**Dose:**
3mg to 5 mg at night. Review continuing need at regular intervals and stop when sleep-wake cycle re-established.
A small study has suggested that a 10mg dose is too high leading to potential carryover effects the next morning.

**Enteral solution:**
Due to cost of the liquid preparation the capsules should be opened and the contents administered via enteral feeding tubes.
GUIDELINE FOR ENTERAL DRUG ADMINISTRATION

**Adult Critical Care**

Clinical guidelines are guidelines only. The interpretation and application of clinical guidelines will remain the responsibility of the individual clinician. If in doubt contact a senior colleague or expert. Caution is advised when using guidelines after a review date. This guideline has been registered with the Mid Trent Critical Care Network.

<table>
<thead>
<tr>
<th>Drug</th>
<th>NG:</th>
<th>NJ:</th>
<th>Cost:</th>
<th>Notes:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amitriptyline</td>
<td>Tablets</td>
<td>Tablets/Liquid</td>
<td>Liquid 25mg/5ml&lt;br&gt;£10.10x150ml&lt;br&gt;Tablets 25mg&lt;br&gt;£0.31x28</td>
<td>Tablets can be crushed and dispersed, but coating may block tubes if not broken up properly. Therefore use with caution for NJ tubes.</td>
</tr>
<tr>
<td>Azithromycin</td>
<td>Suspension</td>
<td>Suspension</td>
<td>Capsules 250mg&lt;br&gt;£1.75x4&lt;br&gt; Liquid 200mg/5ml&lt;br&gt;1.83x15ml</td>
<td>No feedbreak required with suspension.&lt;br&gt;Capsules can be opened, but needs a break 2hrs before and 1hr after dose.</td>
</tr>
<tr>
<td>Ciprofloxacin</td>
<td>Tablets</td>
<td>Tablets</td>
<td>Tablets 250mg&lt;br&gt;£1.58x100&lt;br&gt;Suspension 250mg/5ml&lt;br&gt;£19.80x100ml</td>
<td>Use IV route where possible. Do not use the suspension, as it is very thick and may block the enteral tube. Ciprofloxacin binds to feed, recommended to have a feedbreak 2 hours before and after dose. In practice use at higher end of dosage range (i.e. 750mg BD) particularly for tubes terminating in jejunum and only stop the feed during administration to compensate for lower absorption.</td>
</tr>
<tr>
<td>Citalopram</td>
<td>Tablets</td>
<td>Tablets/Drops</td>
<td>Drops 40mg/ml&lt;br&gt;£4.55x15ml&lt;br&gt;Tablets 20mg&lt;br&gt;£0.24x28</td>
<td>Limited info about crushing and dispersing tablets, therefore use with caution for NJ tubes.</td>
</tr>
<tr>
<td>Creon</td>
<td>See guideline</td>
<td>See guideline</td>
<td>Refer to separate Creon guideline. NB: Pancrex V powder now available.</td>
<td></td>
</tr>
<tr>
<td>Colecalciferol</td>
<td>Liquid</td>
<td>Liquid</td>
<td>Liquid 3000u/ml&lt;br&gt;£45x100ml</td>
<td>No information about crushing tablets.</td>
</tr>
<tr>
<td>Diazepam</td>
<td>Tablets</td>
<td>Tablets</td>
<td>Tablets 5mg&lt;br&gt;£0.31x28&lt;br&gt; Liquid 2mg/5ml&lt;br&gt;£17.18x100ml</td>
<td>Due to cost of suspension crush and disperse tablets for enteral administration.</td>
</tr>
<tr>
<td>Drug</td>
<td>Format</td>
<td>Format</td>
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</tr>
<tr>
<td>Digoxin</td>
<td>Tablets</td>
<td>Tablets</td>
<td>62.5 micrograms</td>
<td>£1.28 x 28</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Liquid</td>
<td>£5.34 x 60ml</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>250 micrograms</td>
<td>£5.34 x 60ml</td>
</tr>
<tr>
<td>Fluconazole</td>
<td>Capsules</td>
<td>Capsules</td>
<td>50 mg</td>
<td>£0.17 x 7</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Suspension</td>
<td>£16.61 x 35ml</td>
</tr>
<tr>
<td>Folic acid</td>
<td>Tablets/Liquid</td>
<td>Tablets/Liquid</td>
<td>£0.18 x 28</td>
<td>£7.50 x 150ml</td>
</tr>
<tr>
<td>Furosemide</td>
<td>Tablets/Liquid</td>
<td>Tablets/Liquid</td>
<td>40 mg</td>
<td>£0.09 x 28</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Liquid</td>
<td>£10.85 x 150ml</td>
</tr>
<tr>
<td>Levofloxacin</td>
<td>Use IV route</td>
<td>Use IV route</td>
<td>£0.88 x 5</td>
<td>Use IV quinolone as preferred option, choice depending on local</td>
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<tr>
<td>Loperamide</td>
<td>Capsules</td>
<td>Capsules</td>
<td>£1.20 x 30</td>
<td>£1.02 x 100ml</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Syrup</td>
<td>£1.02 x 100ml</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>1mg/1ml</td>
<td>£17.77 x 100ml</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>NSM suspension</td>
<td>£17.77 x 100ml</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1mg/1ml</td>
<td>£17.77 x 100ml</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Tablets</td>
<td>£1.96 x 30</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Melatonin</td>
<td>Capsules</td>
<td>Capsules</td>
<td>10 mg</td>
<td>£0.23 x 1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Liquid</td>
<td>£14.21 x 200ml</td>
</tr>
</tbody>
</table>
| **Metformin** | Tablets | Liquid | Tablets 500mg  
£0.30x28  
Liquid 500mg/5ml  
£25x150ml | Sachets have been withdrawn. Tablets are film coated, but can be crushed and dispersed. |
| **Metronidazole** | Tablets | Tablets | Tablet 400mg  
£0.38x21  
Liquid 200mg/5ml  
£14x100ml | Stomach acids are required to break down metronidazole benzoate in the suspension to active metronidazole. Enteral feeds interfere with this. For both NG and NJ administration the tablets should be crushed and dispersed. This avoids need to feedbreaks. |
| **Morphine sulfate MR** | Zomorph capsules (preferred) or MST sachets (restricted use) | Morphine sulfate liquid | Zomorph 10mg  
£1.64x60  
MST Sachets 20mg  
£20.76x30  
Liquid 10mg/ml  
£0.76x100ml | Zomorph capsules can be opened for NG administration, flush tube well. For more info see: [http://nuhnet/diagnostics_clinical_support/pharmacy/therapeutics/Documents/General/Zomorph%20FAQs.pdf](http://nuhnet/diagnostics_clinical_support/pharmacy/therapeutics/Documents/General/Zomorph%20FAQs.pdf)  
Zomorph can block NJ tubes therefore use morphine sulfate liquid for NJ administration. MST sachets are available but use is restricted due to cost. A whole MST sachet must be used as part doses are not accurate. For doses less than 20mg use Zomorph for NG or convert to morphine sulfate liquid for NJ administration. |
| **Multivitamins** | Thiamine tablets, Forceval soluble | Thiamine tablets, Forceval soluble | Forceval soluble  
£7.30x30 | Multivitamin and Vitamin B Co Strong tablets may block enteral tubes if crushed and dispersed, therefore as part of alcohol withdrawal omit these and give thiamine only. Alternatively continue pabrinex after the initial 3-5 day course at 1 pair daily for up to a week total course. Prescribe thiamine and multivitamins on discharge from critical care. Forceval soluble can be used for long stay patients only after discussion on long stay ward round. |
| **Nimodipine** | Tablets/ Suspension | Suspension, but limited data about absorption. Consider using IV | Tablets 30mg  
£40x100  
Suspension 60mg/5ml  
£35x200ml | Crush and disperse the tablets until a suspension can be obtained from pharmacy. A prolonged break in feeding is not required. |
| **Olanzapine** | Orodispersible tablets | Orodispersible tablets | Orodispersible tablets  
5mg £1.78x28 | Disperse orodispersible tablets in water for enteral tube administration. |
<table>
<thead>
<tr>
<th>Drug</th>
<th>Route</th>
<th>Route</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phenytion</td>
<td>Use IV route</td>
<td>Use IV route</td>
<td>Enteral feeds can significantly reduce absorption, a 2 hour feedbreak before and after the dose is required. As patients are fed for 24 hours and may be on sliding scale insulin leave IV in critical care. Usually given as a once daily infusion (see guideline). Liquid should only be used after discussion with the MDT, but absorption may be very poor particularly via NJ. Monitor levels closely.</td>
</tr>
<tr>
<td>Penicillins (Penicillin V, Flucloxacillin)</td>
<td>Suspension</td>
<td>Suspension</td>
<td>Recommended to stop feed 2 hours before and 1 hour after administration due to decreased absorption and reduced peak plasma concentration. In practice leave IV or give an increased enteral dose and just stop feed for time of administration. Contact pharmacy for advice on dosing.</td>
</tr>
<tr>
<td>Prasugrel</td>
<td>Tablets</td>
<td>Tablets</td>
<td>Tablets 10mg £43.52x28</td>
</tr>
<tr>
<td>Prednisolone</td>
<td>Tablets</td>
<td>Tablets</td>
<td>Tablets 5mg 0.24x28 Soluble tablets 5mg £42.78x30</td>
</tr>
<tr>
<td>Quetiapine</td>
<td>Tablets</td>
<td>Tablets</td>
<td>Tablets 25mg 0.58x60</td>
</tr>
<tr>
<td>Rifampicin</td>
<td>Liquid</td>
<td>Liquid (may not be as well absorbed via jejunum)</td>
<td>Liquid 100mg/5ml £5.87x120ml</td>
</tr>
<tr>
<td>Risperidone</td>
<td>Orodispersible tablets/ Liquid</td>
<td>Orodispersible tablets/ Liquid</td>
<td>Orodispersible tablet 1mg £3.63x28 Liquid 5mg/5ml £4.00x100ml</td>
</tr>
<tr>
<td>Spironolactone</td>
<td>Tablets</td>
<td>Tablets</td>
<td>Tablets 25mg 0.62x28 Suspension 25mg/5ml £36.75x125ml</td>
</tr>
<tr>
<td>Theophylline</td>
<td>Contact pharmacy</td>
<td>Contact pharmacy</td>
<td>Numerous products available, contact pharmacy for advice. Enteral feed had a variable effect on absorption just stop feed for time of administration and monitor levels.</td>
</tr>
</tbody>
</table>
| **Trazodone** | Capsule | Capsule | Capsules 50mg £19.85x84  
Liquid 50mg/5ml £30.62x120ml | Due to the cost of the liquid open capsule and disperse contents. |
| **Warfarin** | Tablets | Tablets | Tablets 3mg £0.87x28 | Vitamin K in feeds may interfere with the effect of warfarin. In practice stop feed for time of administration only and monitor INR. |
| **Zopiclone** | Tablets | Tablets | Tablets 7.5mg £0.48x28 | Limited information from reference sources, but from in house experience the film coated tablets may be crushed and dispersed. Flush well for NJ administration. |

Prices correct as of NUH June/July 2014 (excluding VAT).

This list is a guide to commonly used drugs and is not exhaustive. For full details on suitability of medication for enteral administration please refer to:
- BNF for availability of liquid or rectal formulations
- Pharmacy Department

Please note: the administration of all medicines (including liquids) via nasogastric (NG) or nasojejunal (NJ) tubes is off-label with the exception of Zomorph capsules and lansoprazole orodispersible tablets.
Tablets NOT suitable for Enteral administration

1. Enteric coated (e/c)

The enteric coating is designed to prevent drug dissolution in the stomach and to promote absorption in the small intestine. Crushing can lead to either irritancy in the stomach or decreased drug effectiveness due to gastric acid.


These tablets are designed to be released gradually over time. Crushing them can result in the patient receiving the whole dose at once. **Examples include:**

<table>
<thead>
<tr>
<th>Drug</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Longtec (Oxycodone MR)</td>
<td>Convert to Oxynorm liquid (oxycodone IR) four times daily.</td>
</tr>
<tr>
<td>Alendronic acid 70mg once weekly tablet</td>
<td>Omit. For long term enteral administration discuss with pharmacy alternatives. Also withhold any calcium supplements (Calcichew D3, Adcal D3 etc) while patient is in critical care, unless required to treat a low calcium level. Contact pharmacy for advice.</td>
</tr>
<tr>
<td>Diltiazem M/R or LA</td>
<td>Normal release diltiazem suspension made by pharmacy or convert dose to non-MR and crush tablets.</td>
</tr>
<tr>
<td>Isosorbide mononitrate M/R (ISMN)</td>
<td>Convert to an equivalent twice daily dose (morning and lunchtime) of normal release Isosorbide mononitrate.</td>
</tr>
<tr>
<td>Felodipine or Nifedipine MR</td>
<td>Convert to Amlodipine tablets suitable for crushing and dispersing.</td>
</tr>
<tr>
<td>Tegretol Retard (Carbamazepine M/R)</td>
<td>Use Carbamazepine liquid or suppositories (check dose conversion for suppositories).</td>
</tr>
</tbody>
</table>

3. Cytotoxic drugs and hormones

Not suitable to crush tablets or open capsules due to potential risks to the handler.

Discuss with pharmacy
References:

- L Jamieson. Local guidance on drug administration via enteral feeding tubes. Critical care NUH.

DOCUMENT CONTROL

| Version:       | 1                  |
| Changes to this version: | NA                |
| Date:          | September 2014, updated January 2016 |
| Date ratified: | May 2015           |
| Date due for review: | October 2017. Do not use after October 2018 |
| Approval:      | MTCCN Clinical Group |
| Author:        | MTCCN Pharmacy Group |
| Consultation:  | MTCCN Pharmacy Group, Critical Care Nursing Staff MTCCN |
| Distribution:  | Critical Care Units within the Mid Trent Critical Care Network |
IV GENTAMICIN PRESCRIBING IN ADULT CRITICAL CARE

Indication:
Gentamicin is an aminoglycoside antibiotic with bactericidal effects. It is active against most Gram negative bacteria, including *Pseudomonas sp.*, and also against some Gram positive bacteria, including *Staphylococcus aureus* (including MRSA). Gentamicin is used synergistically for *Enterococcus* and *Streptococcus sp.*

Prescribing:
A sticker is available within Critical Care for the prescribing of gentamicin. It should be placed into the antibiotic section of the drug chart.

The Cockcroft-Gault equation is used to calculate creatinine clearance as an estimate of glomerular filtration rate (GFR) for the purpose of drug dosing in renal impairment (Do not use MDRD eGFR from NOTIS): A creatinine clearance calculator is available on the antibiotic intranet site.

\[
\text{CrCl (ml/min)} = F \times (140-\text{age}) \times \text{weight (kg)}
\]

where: 
- \( F = 1.23 \) for male patients,
- \( F = 1.04 \) for female patients

**NOTE:** If patient is anuric, morbidly obese or in acute renal failure this equation will not give a true reflection of CrCl.

If the patient is obese – defined as more than 20% above their ideal body weight (IBW) – a dose correction is required. It is recommended that in these cases the dosing calculator available on the antibiotic intranet site is used. If this is not available the following equations should be used:
IBW for male patients = 50 + (2.3 x (height in inches - 60))
IBW for female patients = 45 + (2.3 x (height in inches - 60))

Calculate dose determining weight (DDW) (kg):
DDW = IBW + 0.4 (actual body weight (kg) - IBW)

Use the dose determining weight to calculate the gentamicin dose required.

**Gentamicin Levels:**

The time and date when levels are to be taken must be clearly annotated on the administration section of the gentamicin prescription sticker including whether the next dose is to be given or withheld until results are available.

- A trough, or pre-dose, level is always required **18-24 hours** after the first dose. This should be sent in a gold top (preferred) or red top sample bottle to clinical chemistry. Levels may be requested 24 hours a day, 7 days per week with results usually available within 2-3 hours. For details on how to complete the sample request form please refer to the antibiotic website.
- In a patient <65 years of age, if the serum creatinine is normal with good urine output give the second dose without waiting for the result. The result must be checked before the third dose.
- In a patient >65 years of age or with abnormal renal function or poor urine output, await the result before giving a second dose.

**Interpretation of levels:** A trough level of < **1mg/L** is required for further doses to be given

- Daily levels are often required in critically ill patients with unstable renal function.
- If the pre-dose level returned is in range (< **1mg/L**): The current once daily dosing regime can be continued. A further pre-dose level should be performed following 3-4 more doses, provided that renal function is stable.
- For trough levels obtained between 1- 2 mg/L repeat the levels every 12 hours until a level <1mg/L is obtained to allow further dosing.
- For trough levels >2mg/L repeat levels every 24 hours.
- Following a dose adjustment levels should be taken **18-24 hours** after the new dose is administered.

**Side effects:**

Gentamicin ototoxicity and nephrotoxicity are associated with high gentamicin levels.

Please contact the Critical Care Pharmacist with any queries.
Guidelines for the use of hypertonic saline (HTS) in the treatment of raised intracranial pressure

Background and Evidence for Use
Hypertonic saline (HTS) may be useful in the treatment of raised intracranial pressure (ICP). The exact mechanism remains to be fully elucidated, animal and human studies suggest that HTS promotes cerebral blood flow (through both expansion of the intravascular volume and reduction of endothelial swelling to improve microcirculation), reduction of oedema via an osmotic effect and direct cerebroprotection.

There are few clinical trials in humans investigating the efficacy of HTS in raised ICP. There is also little data to suggest an optimal dosing regimen for the administration of HTS. The following is an adaptation of existing guidance.

Indication
- Patients with ICP >20mmHg despite conventional therapies to reduce ICP (see algorithm/flow chart)
- Consider use in SAH patients with vasospasm
- The decision to commence HTS must be made by a consultant

Exclusion criteria
- Avoid in patients with existing renal impairment
- Volume overload, avoid in patients with cardiac failure
- Initial serum Na >150mmol/L
- Initial serum osmolality >320mosmol/L

Presentation
2.7% sodium chloride polyfusor (500mL) intravenous infusion containing 0.45mmol Na per mL

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Dosage and Administration

Start IV infusion at 0.5mL/kg/hr via a CENTRAL LINE ONLY
Adjust rate by 0.2mL/kg/hr every 4hrs according to serum Na

Adjustments to the infusion rate from the initial rate must be initiated by medical staff and documented in the medical records and on the 24 hour chart.

Aim for an increase in serum Na of <10mmol/L per day
Target serum Na: 145 -155mmol/L
Target serum osmolality: 300-320mosmol/L

Review indication for HTS every 24hrs. Maximum duration of infusion = 48hrs
After 48hrs wean infusion rate by 0.2mL/kg/hr every 4hrs to avoid rapid correction of serum Na
Discontinuation of HTS:
- HTS should be weaned to correct the sodium by no faster than 0.5mmol per 2 hours.
- The sodium should not be decreased by more than 10 mmols in every 24 hours.

Monitoring:
- Four hourly ABG: check serum Na, K
- Twice daily U&Es, Cr, serum osmolality

Side Effects:
- Electrolyte disturbance, hyperkalaemia or hypokalaemia. Hyperchloraeic metabolic acidosis
- Potential for central pontine myelinosis (osmotic demyelination syndrome) with a rapid increase in serum Na
- Potential for rebound cerebral oedema with rapid correction of hypernatraemia
- Dilutional coagulopathy

Example Prescription:
Example prescription for a 70kg patient.
- Initial infusion rate = 0.5 x 70 = 35mL per hour
- Subsequent infusion rate changes = 0.2 x 70 = 14mL every 4hrs according to serum Na changes.

References:
Adult Critical Care Guidelines for the Management of Idiopathic Hypertension

Excluded other causes for hypertension; pain, agitation, awakening, intracranial pathology, inaccurate reading, high sympathetic drive

If neurosurgical patient consider β-blocker 1st line

Calcium channel blocker: amlodipine 5 mg OD. Titrate to max 10mg OD

Target blood pressure achieved?

Add angiotension converting enzyme inhibitor (ACEi) ramipril 1.25mg OD. Titrate to max 10mg daily

Target blood pressure achieved?

Add alpha-blocker doxazosin 1-2 mg OD. Titrate to max 16mg OD

Target blood pressure achieved?

Yes

Absorbing Enterally?

N

IV GTN or IV hydralazine (usually in combination with β-blocker)

Review and rationalise antihypertensive medication on critical care discharge. NICE guidelines of calcium channel blocker and ACEi desirable.

N

Target blood pressure achieved after Labetalol dose optimised?

Yes

IV labetalol (α, β action) bolus or infusion

Target blood pressure achieved?

N

No NG?

Occasionally consider sublingual captopril

No NG?

Consider addition of β-blocker if evidence of sympathetic stimulation

N

Is the SBP > 220 mmHg or is DBP > 110 mmHg for at least 30 minutes?

Confirm if taking antihypertensives on admission. Restart as appropriate.

Y

Does patient have a history of asthma/COPD or bradycardia?

N

Y
Guidelines for the Use of Nebulised Iloprost

**Therapeutic Indication**
Treatment of Pulmonary Hypertension and Hypoxaemia in patients with severe acute respiratory failure NOT responding to maximal medical intervention and in whom patient proning is contra-indicated or results in rapid patient deterioration.

**Action**
A selective pulmonary artery vasodilator that interferes with the mechanism of hypoxic pulmonary vasoconstriction resulting in reduced pulmonary vascular resistance, improved blood flow and venous oxygen saturation.

**Contra-indications to use**
- Severe coronary heart disease or unstable angina; myocardial infarction within the last six months; severe arrhythmias; cerebrovascular events within the last 3 months.
- Pulmonary hypertension due to venous occlusive disease.

**Cautions to use**
- Clinical conditions where the effects of Iloprost on platelet aggregation/adhesion may increase the risk of haemorrhage e.g. intracranial haemorrhage, active peptic ulcer, trauma

**Presentation**
10 microgram/ml nebuliser solution (1ml vial Brand name Ventavis)

**Prescribing**
Iloprost 5 micrograms nebulised six to nine times a day, gradually titrated to a maximum of 20 micrograms two to four hourly if an inadequate response is achieved at lower doses.
(Higher than licensed doses based on practical experience of reduced drug delivery via ventilator driven nebulisation)

**Administration**
Calculated dose must be further diluted to a total volume of 3ml with Sodium chloride 0.9% and then nebulised via the nebuliser pot on the ventilator circuit
**Discard any unused solution as single use nebuliser**

**Undesirable effects**
- Hypotension, vasodilation, bradycardia and tachycardia, ventilation perfusion mismatching, bronchoconstriction, mouth and throat irritation, Rash

**Notes**
- Manufacturers have quoted a pulmonary vasodilator effect of nebulised iloprost lasting up to two hours.
- Use to be audited on a case by case basis

**References:**
   accessed via http://err.ersjournals.com/content/18/111/29.full.pdf+
Guidelines for the Use of Intravenous Immunoglobulin

Background

A Department of Health demand management plan and national clinical guideline exists for the use of immunoglobulin. The aim is ensure prescribing is inline with these national guidelines and to restrict the use of immunoglobulin to patients where there are no alternative treatments and whom are likely to benefit the most especially during times of reduced availability of immunoglobulin. This guideline outlines the appropriate use of immunoglobulin within adult critical care.

Presentation

There are several brands of immunoglobulin. Within Critical Care: Privigen is recommended for all new, short term treatments independent of renal function.

- Available as: 5g in 50ml vial
- 10g in 100ml vial
- 20g in 200ml vial

When prescribing rounding to the nearest whole vial is recommended to conserve immunoglobulin supplies (for 5 day treatment courses this can be done for the whole course)

Prescribing

It is essential that at the time of prescribing the consultant or prescriber (registrar or above within critical care) completes the NUH electronic request form to ensure NUH complies with DoH recommendations to ensure its use is captured on a national database and to enable funding to be received. NO form means NO payment. Please document in the medical records that the electronic form has been completed.

(Guillain Barre Syndrome (GBS) (red indication) & Myasthenia Gravis (blue indication)

- IV infusion 0.4 grams per kg per day for 5 days

Selection criteria for use in GBS – significant disability (Hughes Grade 4) OR disease progression.
Selection Criteria for Myasthenia Gravis – Diagnosis by neurologist; OR Acute Myasthenic crisis OR other treatments are ineffective or inappropriate.

Use must be recommended by a consultant. The neurology consultant must be made aware of the case if not the prescriber.)
Toxic epidermal necrolysis (TEN), Stevens Johnson Syndrome (red indication)

IV infusion **2g per kg preferably as a single dose** or divided over 3 consecutive days

**Selection criteria for use** - Diagnosis must be made by a dermatology consultant and involve more than 10% of the body area; AND when other treatment are contra-indicated or condition life threatening

Staphylococcal or Streptococcal toxic shock syndrome or Necrotising (PVL associated )

**Staphylococcal Sepsis** (blue indication)

- IV infusion **2g per kg as a single dose**

**Selection criteria for use** - Diagnosis of streptococcal or Staphylococcal TSS, preferably with isolation of the organism; AND failure to achieve rapid improvement with antibiotic therapy and other supporting measures; AND Life-threatening.

Must be recommended by a critical care consultant. A microbiology consultant (or registrar out of hours) must also be involved in the decision to prescribe.

**Colour classification** - full document available via the DTC immunoglobulin website:

- **Red** = Disease where treatment is considered highest priority. Risk to life without treatment. Automatic approval for use granted.

- **Blue** = Disease where there is a reasonable evidence base but where other treatment options are available. Reduced use in times of shortage. Provided the selection criteria is met for each indication then automatic approval is granted. (retrospective sign off by Immunoglobulin panel). If criteria not met approval should be sought from the panel. Out of hours approval should be sought from the consultant on call for the speciality represented on the panel. Two approving consultants required.

**Dosing in Obesity**

There is no clear guidance regarding dosing in obesity. However as immunoglobulin poorly distributes into adipose tissue using dose determined weight (DDW) to calculate immunoglobulin dosage in obese patients (>20% above their ideal body weight (IBW)) appears most appropriate:

\[
\text{IBW for males (kg)} = 50 + (2.3 \times \text{height in inches} - 60) \\
\text{IBW for females (kg)} = 45.5 + (2.3 \times \text{height in inches} - 60) \\
\text{DDW} = \text{IBW} + 0.4 \times (\text{actual body weight (kg)} - \text{IBW})
\]
**Prescription** Prescribe daily dose on the general drug chart as well as the back of the drug chart. *(as the infusion section of the back of the drug chart is rarely used within critical care)*

Batch number stickers for each bottle should be attached to the back of the drug chart on the infusion section.

**Example Prescription:**

<table>
<thead>
<tr>
<th>Immunoglobulin (Specify brand)</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dose</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Dose in grams</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Route</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>IV</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Start date</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Stop/Review Date</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Additional Instructions/Indication</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prescribe infusion rate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Add max rate if appropriate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Pharm screen</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Pharm supply</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Print Name and Bleep</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>A Doctor</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Signature</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Side effects**

- Allergic reactions / anaphylaxis / shock, including a sudden fall in BP, Chills/ Fever, Headache, nausea, joint pains, - *consider rate reduction*
- Rare reports of acute renal failure, aseptic meningitis, haemolytic anaemia,

**Thrombotic events** have been associated with the administration of intravenous immunoglobulin (MI, PE, DVT, stroke). A rapid rate of infusion has been identified as a risk factor for thrombotic events. Consider reducing the maximum rate of infusion in patients with a history of cardiovascular/ vascular disease and/or thrombotic risk factors. Ensure all patients receive Enoxaparin thromboprophylaxis as appropriate.

**Administration rate:** Infusion via a dedicated central or peripheral line.

In acute renal failure and/or fluid overloaded patient’s the total volume to infuse may limit the rate of infusion. Add a maximum rate of infusion to the prescription as appropriate.

Start at 0.3ml/kg/hour for the first 30 minutes if tolerated increase to 0.6ml/kg/hr for 30 minutes then double the rate every 30 minutes until a maximum rate of 4.8ml/kg/hr is reached.

**KIOVIG or VIGAM** may be requested by Haematology and Immunology Consultants. In this case local guidance to the specialities should be referred to. Full administration guidance for KIOVIG and VIGAM is available on the IVIG website-

http://nuhnet/diagnostics_clinical_support/pharmacy/therapeutics/Pages/IntravenousImmunoglobulin.asp
References:

Glycaemic Control in Hyperglycaemic Adult Critical Care Patients (guideline summary)

On admission to Adult Critical Care:
All patients should have a blood glucose measurement on admission

<table>
<thead>
<tr>
<th>Blood glucose level</th>
<th>Actions</th>
<th>Next Blood Glucose</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 2.2mmol/L</td>
<td>• Inform medical staff. Consider the need to implement the Patient Group Direction (PGD) for 20% glucose administration</td>
<td>within 15 minutes</td>
</tr>
<tr>
<td>&lt; 4mmol/L</td>
<td>• Inform medical staff, who should identify the cause and consider treating for hypoglycaemia.</td>
<td>within 15 minutes</td>
</tr>
<tr>
<td>4-10mmol/L</td>
<td>• No Action</td>
<td>1 hour</td>
</tr>
</tbody>
</table>
| 10.1 - 15 mmol/L    | • If blood glucose > 10mmol/L on two consecutive samples, ensure the patient is fed (oral, enteral or parenteral), or receiving a glucose-containing infusion and commence insulin infusion: see standard variable rate infusion regime.  
• Check urine for ketones – if diabetic ketoacidosis present follow separate guidelines. | 1 hour |
| > 15.1mmol/L        | • Inform medical staff – commence insulin infusion see standard variable rate infusion regime.  
• Check urine for ketones – if diabetic ketoacidosis present follow separate guidelines. | 1 hour |

Blood glucose levels whilst on Critical Care (after initial admission-maintenance regime)

<table>
<thead>
<tr>
<th>Blood glucose level</th>
<th>Actions &amp; Insulin Infusion Rate</th>
<th>Next Blood glucose</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 2.2mmol/L</td>
<td>• Inform medical staff. Consider the need to implement the Patient Group Direction (PGD) for 20% glucose administration</td>
<td>within 15 minutes</td>
</tr>
</tbody>
</table>
| < 4 mmol/L          | • Inform medical staff - consider treating for hypoglycaemia and STOP variable rate infusion if already commenced  
• Recheck level.  
• Check that feeding and/or glucose has not been stopped. | within 15 minutes |
| 4-6 mmol/L          | • No Action | 2 hours  
(4 hours if last two blood glucose levels were 4.6 -10 mmol/L) |
| 6.1 - 10 mmol/L     | • No Action, unless the patient is known to be an Insulin-Dependent Diabetic or has had a total resection of the pancreas – if so follow separate variable rate infusion (see page 6). | |

For all results > 10 mmol/L: Confirm that there has been no contamination of samples with glucose (for example by having glucose in the arterial line flush).

If blood glucose > 10mmol/L on two consecutive samples, ensure the patient is fed (oral, enteral or parenteral), or receiving a glucose-containing infusion and commence insulin infusion:

<table>
<thead>
<tr>
<th>Blood glucose level</th>
<th>Insulin infusion</th>
<th>Next Blood glucose</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.1-12 mmol/L</td>
<td>1 unit/hour</td>
<td>1 hour</td>
</tr>
<tr>
<td>12.1-15 mmol/L</td>
<td>2 units/hour</td>
<td>1 hour</td>
</tr>
<tr>
<td>15.1-18 mmol/L</td>
<td>3 units/hour</td>
<td>1 hour</td>
</tr>
<tr>
<td>&gt; 18 mmol/L</td>
<td>4 units/hour AND inform medical staff</td>
<td>1 hour</td>
</tr>
</tbody>
</table>
Glycaemic Control in Hyperglycaemic Adult Critical Care Patients

Where patients are persistently >14 mmol/L a more aggressive sliding scale regimen maybe used—Consult medical staff

Before commencing insulin infusion ALWAYS double-check blood sugar using a different technique (e.g. finger-prick or arterial line or venous laboratory sample)

Before commencing an insulin infusion ALWAYS double check that the pressure line monitoring fluid DOES NOT CONTAIN GLUCOSE

Where patients are found to have stable blood sugar control, the frequency of blood sugar measurements may be reduced to 6 or 12 hourly – if approved by a consultant or senior ICU trainee

<table>
<thead>
<tr>
<th>Other actions</th>
<th>Actions</th>
<th>Next Blood glucose</th>
</tr>
</thead>
<tbody>
<tr>
<td>If feeding is started</td>
<td></td>
<td>1 hour</td>
</tr>
<tr>
<td>If feeding is stopped</td>
<td>Stop insulin OR commence glucose containing infusion</td>
<td>1 hour</td>
</tr>
<tr>
<td>If treatment for hypoglycaemia is needed</td>
<td></td>
<td>15 minutes</td>
</tr>
<tr>
<td>If high concentration glucose infusions are used (e.g. for the treatment of hyperkalaemia)</td>
<td></td>
<td>1 hour, if not sooner</td>
</tr>
<tr>
<td>If there is new sweating, loss of consciousness, tachycardia, or hypotension:</td>
<td>Check blood glucose level immediately</td>
<td></td>
</tr>
</tbody>
</table>
Glycaemic Control in Hyperglycaemic Adult Critical Care Patients

If the patient is known to be an **Insulin-requiring Diabetic** or has had a **total resection of the pancreas**:

- The standard variable rate insulin scale pre-printed on the Adult Critical Care infusions chart **MUST be scored out** and replaced with the following:

<table>
<thead>
<tr>
<th>Blood glucose level</th>
<th>Actions</th>
<th>Next Blood glucose</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 2.2mmol/L</td>
<td>• Inform medical staff. Consider the need to implement the Patient Group Direction (PGD) for 20% glucose administration</td>
<td>within 15 minutes</td>
</tr>
</tbody>
</table>
| < 4 mmol/L          | • Inform medical staff - consider treating for hypoglycaemia and **STOP** variable rate infusion if already commenced.  
  • Recheck level  
  • Check that feeding and/or glucose has not been stopped. | within 15 minutes |
| 4-6 mmol/L          | No Action | 2 hours |
| 6.1-10 mmol/L       | Insulin infusion: 1 unit/hour | 1 hour |
| 10.1-12 mmol/L      | Insulin infusion: 2 units/hour | 1 hour |
| 12.1-15 mmol/L      | Insulin infusion: 3 units/hour | 1 hour |
| 15.1-18 mmol/L      | Insulin infusion: 4 units/hour | 1 hour |
| > 18 mmol/L         | Insulin infusion: 5 units/hour **AND** inform medical staff | 1 hour |

Where patients are persistently >14 mmol/L or if patients are normally managed using high doses of insulin when well, a more aggressive sliding scale regimen may be used **Consult medical staff**

*(for DKA follow separate Trust guidelines)*
Instructions on what kind of blood glucose sample to use in Adult Critical Care

Does the patient have an arterial line?
Use the same sampling method as much as possible - only change from finger-prick techniques if a new arterial line is inserted

YES

Check the Flush Bag
Make sure it is 0.9% Sodium Chloride

YES

Check blood glucose using ABL 90 blood gas analyser

RESULT:
- Result < 4mmol/L or >18mmol/L
  - Inform medical staff. Double-check result using fresh arterial/venous sample using ABL 90 blood gas analyser AND send a venous laboratory blood glucose sample.
- Result > 10 or <18mmol/L
  - Is an insulin infusion already in progress?
    - YES
      - Follow insulin protocol
    - NO
      - If the result is >10mmol/L on two consecutive samples then:
        - Before starting or restarting an insulin infusion, perform a double-check using a finger-prick sample on a handheld Abbott Freestyle glucose meter.
        - If the result is <9mmol/L do NOT commence insulin unless patient is an insulin-requiring diabetic or has had a total resection of the pancreas (see guidelines)

RESULT:
- Result < 4mmol/L or >18mmol/L
  - Inform medical staff. Double-check result using fresh finger-prick sample using a handheld Abbott Freestyle glucose meter AND send a venous laboratory blood glucose sample.

If there is ever doubt or there is an unexpected result, send a venous laboratory blood glucose sample

If there is profound hypoxia, the ABL 90 blood gas analyser will NOT report a glucose - in this situation perform a finger-prick sample using a handheld Abbott Freestyle glucose meter
Variable Rate Intravenous Insulin Infusions

Insulin infusions should be prescribed according to the pre-printed prescription on the Adult Critical Care Intravenous Infusion Chart.

The target blood glucose is ≤10 mmol/L.

Insulin infusions should be made up using Human Actrapid Insulin.

50 units of insulin (drawn up in INSULIN SYRINGE) should be added to 49.5 mls of Sodium Chloride 0.9% to make a total volume of 50mls

The Standard Variable Rate scale is pre-printed as below. (Not to be used for Insulin-requiring diabetics or total resection of the pancreas patients)

This scale should be modified accordingly if there are repeated hypoglycaemic episodes (Blood Glucose < 2.2mmol/L) or if glycaemic control is not adequately gained (Blood Glucose repeatedly >14mmol/L). Modifications should be written in the blank sections and the standard scale crossed out.

<table>
<thead>
<tr>
<th>Blood Glucose level mmol/L</th>
<th>Insulin Rate Units / Hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.1-10</td>
<td>0</td>
</tr>
<tr>
<td>10.1-12</td>
<td>1</td>
</tr>
<tr>
<td>12.1-15</td>
<td>2</td>
</tr>
<tr>
<td>15.1-18</td>
<td>3</td>
</tr>
<tr>
<td>&gt;18</td>
<td>4 &amp; contact Medical Staff</td>
</tr>
</tbody>
</table>

Stopping feed

Insulin infusions MUST be accompanied by either a glucose-containing infusion or parenteral feed (PN) or enteral feed (NG, NJ or Jejunostomy feeding)

If feeding is stopped the insulin MUST also be stopped, or a glucose-containing infusion commenced

Management of severe hypoglycaemia (<2.2 mmol/L)

- Recheck blood glucose to confirm hypoglycaemia (BM <2.2mmol/L)
- Stop infusion of Actrapid insulin
- Send a laboratory blood glucose sample
- Give 20mls of 50% glucose IV (or 100ml of 20% glucose IV)
- Recheck blood glucose and recommence hourly blood sugar measurements
- Consider cause of hypoglycaemic episode- For example failure to absorb feed
Blood sugar levels **MUST** be checked in the event of sudden LOSS OF CONSCIOUSNESS, SWEATING, TACHYCARDIA and/or HYPOTENSION

**Diabetic Ketoacidosis (DKA)**

Patients admitted to Adult Critical Care with a diagnosis of Diabetic Ketoacidosis (DKA) **should be** treated according to separate NUH guidelines which can be found on the intranet / or using the available pre-printed drugs charts.

**Patients known to have diabetes prior to admission to Adult Critical Care**

All patients admitted to Adult Critical Care will have their blood sugar assessed according to the above guidelines.

All **unstable** patients will be managed according to the above guidelines, regardless of whether or not they were known to have diabetes prior to Adult Critical Care admission.

Where patients are **stable** and are known to have diabetes prior to admission to Adult Critical Care it may become appropriate to restart their normal anti-diabetic medications, which may include oral anti-diabetic tablets or subcutaneous insulin preparations. It is rarely appropriate for this to happen in patients who are not fully conscious, receiving 24 hour continuous enteral feeds/TPN, or who are level 3 patients.

If oral anti-diabetic medications are restarted whilst on critical care then the insulin **MUST** be discontinued after 1 hour, the patient **MUST** be being fed, and blood glucose must be checked 2 hourly for a minimum of 6 hours after the first tablet.

If subcutaneous insulin preparations are restarted whilst on critical care, then stop the insulin infusion 1 hour after the first subcutaneous injection of insulin. The patient **MUST** be being fed. The subcutaneous insulin **MUST** be prescribed on the NUH Hospital insulin prescription sheet, and blood glucose **MUST** be checked hourly for the first 2 hours and 2 hourly after that for the first 24 hours.
Discharge from Adult Critical Care

In a ward environment, the dangers of hypoglycaemia left un-monitored outweigh the benefits of glycaemic control. A previously non-insulin requiring patient requiring less than 2 units/hour can be discharged without insulin.

The blood glucose should be checked within 4 hours of stopping the infusion.

If insulin of > 2 units/hour is required to maintain blood sugars then a sliding scale must prescribed on the NUH hospital insulin prescription sheet and the receiving team informed and asked to refer the patient, as a new or undiagnosed diabetic, to an appropriate physician or endocrinologist.

For full critical care insulin guideline October 2016 please see NUH intranet
Guidelines for the Use of Ketamine for Acute Inpatient Pain Management

Background and Therapeutic Indication:
Ketamine is an anaesthetic agent that at sub-anaesthetic doses has good analgesic properties without notable respiratory depression. It is indicated in the management of for neuropathic pain (including phantom limb); hyperalgesic states; pain with poor response to opioids; patients with previous history of high opioid consumption preceding injury/surgery and in the management of pain in patients whom are over sedated with opioids but have not yet achieved adequate analgesia. It is commonly used in conjunction with other pain management strategies including: paracetamol, NSAIDs, epidurals, opioid PCAs/oral opioids and has been shown to have an opioid sparing effect.

Presentation and Administration:

At NUH only one strength of Ketamine injection is stocked 500mg in 10ml Ketamine suspension 50mg/5mL is available from pharmacy for oral administration.

Compatibility:
Ketamine may be co-infused on the same line (Y-site) as morphine PCA.

Prescribing:
To be prescribed on separate ketamine infusion chart (NUH02578N).
IV infusion : 100mg in 50mL sodium chloride 0.9% (2mg/mL).

Usual starting rate of 0-5mL/hour, which can be titrated up to maximum 7.5mL/hour. If greater than 7.5mL/hour required, contact pain team for advice.

When converting from IV to oral it is not necessary to wean IV ketamine; stop infusion as the first dose of oral ketamine is given. Peak plasma concentration is 30 minutes after oral dosing.

Oral: usual starting dose 10-20mg (1ml to 2ml) four times a day
Renal impairment – no dose alteration required.
Hepatic impairment – dose reduction should be considered.

Contra-indications:
Cerebral trauma/raised ICP, Myasthenia Gravis, unstable heart disease

Cautions:
Alcohol/drug addiction, hypertension/tachycardia, psychiatric history with a predisposition to hallucinations or nightmares.

Undesirable Effects:
Raised ICP, arrhythmias, euphoria, dysphasia, double vision, vivid dreams and hallucinations – uncommon at doses routinely used (if occurs, consider reducing the dose).
References:

2. Subraniam K, Subraniam S, Steinbrook RA. Ketamine as an adjuvent to analgesic opioids: A quantitative and qualitative systematic review. Anesth Analg 2004; 99: 482 - 95


Guidelines for the Management of Local Anaesthetic Systemic Toxicity (LAST)

Signs of Local Anaesthetic Toxicity?

CNS: Sudden alteration in mental state or loss of consciousness with or without seizures.

CVS: Cardiovascular collapse; conduction blocks, sinus bradycardia, asystole and ventricular tachyarrhythmia

CALL FOR HELP

Stop injecting the local anaesthetic (LA) or infusion devices (Remember epidurals and wound infusion catheters)

Maintain Airway

Give 100% Oxygen
Ensure Adequate Lung Ventilation

Confirm/Establish IV Access

Control Seizure

Give Benzodiazepine, Thiopentone or Propofol in small incremental doses (If unfamiliar with doses, call anaesthetic or Intensive care support)

This guideline has been adapted from the Association of Anaesthetists of Great Britain & Ireland. This guideline is not a standard of medical care. The ultimate judgement with regard to a particular clinical procedure or treatment plan must be made by the clinician in the light of the clinical data presented and the diagnostic and treatment options available.
Management of cardiac arrest associated with local anaesthetic toxicity.

Start cardiopulmonary resuscitation as per protocol

Manage arrhythmias using ALS / APLS protocols – arrhythmias may be refractory to treatment. **DO NOT GIVE LIDOCAINE** as an anti-arrhythmic treatment.

Treat with Lipid Emulsion - Intralipid (see below).

Prolonged resuscitation may be necessary as recovery from LA induced cardiac arrest may take >1 hour
Management of cardiac arrest associated with local anaesthetic toxicity.

For the location of Local Anaesthetic Toxicity Treatment boxes containing Intralipid and weight specific doses, see Appendices.

Using a syringe, draw up a 1.5 ml/kg bolus from 20% Intralipid bag and give immediately IV over 1 minute.

Follow immediately with an infusion via giving set and pump at a rate of 15 ml/kg/hr.

The bolus dose can be repeated a further 2 times at 5 minute intervals if circulation has not been restored.

5 minutes after the infusion has commenced, increase the rate to 30 ml/kg/hr if an adequate circulation has still not been restored.

Continue infusing until CVS stability returns or maximum dose of Intralipid is given. The AAGBI recommendation is that a total dose of 12ml/kg should not be exceeded.
Table of doses of Intralipid bolus and infusions in ml according to weight.

<table>
<thead>
<tr>
<th>WEIGHT In kg</th>
<th>Maximum cumulative dose 12 ml/kg</th>
<th>BOLUS 1.5 ml/kg IV over 1 minute (Max 3 Bolus Doses)</th>
<th>INFUSION Start at: 15 ml/kg/hr</th>
<th>INFUSION Increase to 30 ml/kg/hr If inadequate circulation persists</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>12 ml</td>
<td>1.5 ml</td>
<td>15 ml/hr</td>
<td>30 ml/hr</td>
</tr>
<tr>
<td>2</td>
<td>24 ml</td>
<td>3.0 ml</td>
<td>30 ml/hr</td>
<td>60 ml/hr</td>
</tr>
<tr>
<td>3</td>
<td>36 ml</td>
<td>4.5 ml</td>
<td>45 ml/hr</td>
<td>90 ml/hr</td>
</tr>
<tr>
<td>4</td>
<td>48 ml</td>
<td>6.0 ml</td>
<td>60 ml/hr</td>
<td>120 ml/hr</td>
</tr>
<tr>
<td>5</td>
<td>60 ml</td>
<td>7.5 ml</td>
<td>75 ml/hr</td>
<td>150 ml/hr</td>
</tr>
<tr>
<td>6</td>
<td>72 ml</td>
<td>9.0 ml</td>
<td>90 ml/hr</td>
<td>180 ml/hr</td>
</tr>
<tr>
<td>7</td>
<td>84 ml</td>
<td>10.5 ml</td>
<td>105 ml/hr</td>
<td>210 ml/hr</td>
</tr>
<tr>
<td>8</td>
<td>96 ml</td>
<td>12.0 ml</td>
<td>120 ml/hr</td>
<td>240 ml/hr</td>
</tr>
<tr>
<td>9</td>
<td>108 ml</td>
<td>13.5 ml</td>
<td>135 ml/hr</td>
<td>270 ml/hr</td>
</tr>
<tr>
<td>10</td>
<td>120 ml</td>
<td>15.0 ml</td>
<td>150 ml/hr</td>
<td>300 ml/hr</td>
</tr>
<tr>
<td>15</td>
<td>180 ml</td>
<td>22.5 ml</td>
<td>225 ml/hr</td>
<td>450 ml/hr</td>
</tr>
<tr>
<td>20</td>
<td>240 ml</td>
<td>30.0 ml</td>
<td>300 ml/hr</td>
<td>600 ml/hr</td>
</tr>
<tr>
<td>25</td>
<td>300 ml</td>
<td>37.5 ml</td>
<td>375 ml/hr</td>
<td>750 ml/hr</td>
</tr>
<tr>
<td>30</td>
<td>360 ml</td>
<td>45.0 ml</td>
<td>450 ml/hr</td>
<td>900 ml/hr</td>
</tr>
<tr>
<td>35</td>
<td>420 ml</td>
<td>52.5 ml</td>
<td>525 ml/hr</td>
<td>1050 ml/hr</td>
</tr>
<tr>
<td>40</td>
<td>480 ml</td>
<td>60.0 ml</td>
<td>600 ml/hr</td>
<td>1200 ml/hr</td>
</tr>
<tr>
<td>45</td>
<td>540 ml</td>
<td>67.5 ml</td>
<td>675 ml/hr</td>
<td>1350 ml/hr</td>
</tr>
<tr>
<td>50</td>
<td>600 ml</td>
<td>75.0 ml</td>
<td>750 ml/hr</td>
<td>1500 ml/hr</td>
</tr>
<tr>
<td>55</td>
<td>660 ml</td>
<td>82.5 ml</td>
<td>825 ml/hr</td>
<td>1650 ml/hr</td>
</tr>
<tr>
<td>60</td>
<td>720 ml</td>
<td>90.0 ml</td>
<td>900 ml/hr</td>
<td>1800 ml/hr</td>
</tr>
<tr>
<td>70</td>
<td>840 ml</td>
<td>100 ml</td>
<td>1000 ml/hr</td>
<td>2000 ml/hr</td>
</tr>
<tr>
<td>80</td>
<td>960 ml</td>
<td>120 ml</td>
<td>1200 ml/hr</td>
<td>2400 ml/hr</td>
</tr>
<tr>
<td>90</td>
<td>1080 ml</td>
<td>135 ml</td>
<td>1350 ml/hr</td>
<td>2700 ml/hr</td>
</tr>
<tr>
<td>100</td>
<td>1200 ml</td>
<td>150 ml</td>
<td>1500 ml/hr</td>
<td>3000 ml/hr</td>
</tr>
</tbody>
</table>
Contents and location of Local Anaesthetic Systemic Toxicity Treatment boxes

The Trust has Yellow Treatment Boxes for use in Local Anaesthetic Systemic Toxicity. They are kept in specific locations together with management protocols to aid dosing.

This protocol can also be found on the trust intranet via [http://www.nuh.nhs.uk/healthcare-professionals/clinical-guidelines](http://www.nuh.nhs.uk/healthcare-professionals/clinical-guidelines)

<table>
<thead>
<tr>
<th>Contents of Local Anaesthetic Systemic Toxicity Boxes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copy of Management Guideline</td>
</tr>
<tr>
<td>Intralipid 20% 250ml</td>
</tr>
<tr>
<td>Intralipid 20% 500ml</td>
</tr>
<tr>
<td>Luer-Lok Syringe 50ml</td>
</tr>
<tr>
<td>Luer Needle 0.8x40mm (green)</td>
</tr>
<tr>
<td>Infusion Set</td>
</tr>
<tr>
<td>Chlorhexidine 2 % wipes</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Location of Local Anaesthetic Systemic Toxicity Management Boxes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>City Campus</strong></td>
</tr>
<tr>
<td>Cardiac Theatre 9 Anaesthetic Room</td>
</tr>
<tr>
<td>Carrell Ward (with HUB drugs)</td>
</tr>
<tr>
<td>Critical Care 11-16 (with HUB drugs)</td>
</tr>
<tr>
<td>Day Surgery Unit, Recovery (Defib Trolley)</td>
</tr>
<tr>
<td>EAU (With HUB drugs)</td>
</tr>
<tr>
<td>Edward 2 Ward (Cardiac Arrest trolley)</td>
</tr>
<tr>
<td>Fleming Ward (with HUB drugs)</td>
</tr>
<tr>
<td>Labour Suite (Defib Trolley)</td>
</tr>
<tr>
<td>Main Theatre (Recovery + Defib Trolleys)</td>
</tr>
<tr>
<td>Obstetric Theatre (Defib Trolley)</td>
</tr>
<tr>
<td>Surgical Short Stay Unit</td>
</tr>
</tbody>
</table>
Follow-up action:

1. Report cases from the United Kingdom to the National Patient Safety Agency (via www.npsa.nhs.uk).
2. Whether or not Intralipid is administered, please also report cases to the LipidRescueTM site: www.lipidrescue.org.
3. If possible, take blood samples into a plain tube and a heparinised tube before and after Intralipid administration and at 1 h intervals afterwards. Ask your laboratory to measure LA and triglyceride levels (these have not yet been reported in a human case of LA intoxication treated with lipid).

References

1. AAGBI Safety Guide Management of Severe Local Anaesthetic Toxicity 2010
7. www.lipidrescue.org

Authors

Dr Deborshi Sinha Dr Jessica Flack
Dr Hannah King
Dept of Anaesthetics, April 2015
Guidelines for the Use of Peripheral Metaraminol

**Therapeutic Indication:**
Metaraminol is a sympathomimetic drug which raises blood pressure by predominantly acting on alpha-adrenergic receptors to constrict peripheral vessels and raise blood pressure. Metaraminol should only be used as a short-term, emergency treatment, for hypotension whilst awaiting: the insertion of a central venous catheter or resolution of the shocked state (following fluid resuscitation, weaning of epidural rate or response to antibiotics).

**Contraindications:**
The use of metaraminol is contraindicated in patients on concurrent Monoamine Oxidase Inhibitors (MAOI's) or if these agents have been taken in the preceding 14 days.

**Cautions:**
Asthmatics; The preservatives in metaraminol have been reported to cause hypersensitivity. Sodium bisulphate in particular is associated with circulatory collapse and depression of the CNS in susceptible individuals, namely patients with asthma.
Patients on Digoxin may experience increased ectopic dysrhythmias

**Presentation:** Metaraminol tartrate 10mg in 1ml vial

**Prescribing:**
Metaraminol should only be prescribed by an ST3 or above, trained and currently practicing within Critical Care.

**Bolus injection:**
In an emergency situation a dose of 0.5 mg – 5mg may be given into a large peripheral vein, as a slow IV bolus, over 1-2 minutes. This may be followed by a continuous infusion. The recommended dilution for the bolus is 10mg metaraminol in 20mls NaCl 0.9%. (0.5mg/ml). However in an emergency metaraminol can be given undiluted. This must be given by a doctor. Following a single injection the onset of action is within 1-2 minutes with an approximate duration of action of around 20-60 minutes.

**Intravenous infusion:**
Prepared as 20mg (2x 10mg in 1ml ampoules) diluted to 40ml sodium chloride 0.9% or glucose 5%, administered via a syringe pump via large peripheral vein (ideally antecubital fossa). A typical starting rate is 0.5milligrams /hr (1ml/hr) unless guided by the doctor. The rate of infusion should be titrated to maintain the patient’s blood pressure within prescriber specified parameters. It is recommended that the infusion rate should be adjusted at 10 minute intervals until the desired blood pressure is achieved. Usual rate range 0-20ml/hr (0-10 milligrams/hr). On discontinuation, wean infusion. Avoid abrupt withdrawal.

**Dose adjustments required in renal or hepatic Impairment:**
In hepatic impairment use with caution as metaraminol is hepatically metabolised and therefore may accumulate in patients with liver impairment or cirrhosis. No dosage adjustment is required in renal impairment.
Side effects Include:

Hypertension, Cardiac arrhythmias, Bradycardia, and Urinary retention. Tissue necrosis is possible if extravasation occurs- see notes below.
For a full list of side effects and drug interactions please refer to Summary of product Characteristics (SPC) via www.medicines.org.uk

Extravasation:
If extravasation occurs the area should be injected subcutaneously, as soon as possible with 5-10mg of phentolamine diluted in 10-15ml NaCl 0.9% using a fine hypodermic needle.

If required phentolamine is stocked in Theatre 10 and 20 at City, and at QMC in ED and East Theatre Recovery.

Trust policy on extravasation should be followed. Further information on the general management of extravasation can be found at www.extravasation.org.uk

References:
- ABPI: Medicines Compendium. London: Datapharm Communications Ltd [2016].
- Dart R: Medical Toxicology; Lippincott Williams & Wilkins [Third Edition] [2004]
Guidelines for Administration of Pancrex V Powder via Enteral Feeding Tubes in Adult Critical Care

Pancrex V Powder is a mixture of enzymes (protease, lipase and amylase) designed to aid digestion in patients who are unable to produce sufficient of their own enzymes secondary to disease.

Dose

A typical starting dose for an adult with a feeding regime via an enteral feeding tube in-situ is: 1g (one level 2.5mL spoonful (provided by pharmacy) every 4 hours - only for the duration of the feed. Dosage range 1g to 4g four hourly as needed.

The following advice applies for the administration of Pancrex V Powder to patients with enteral feeding tubes within critical care areas only:

**NG/NJ tubes** – Dissolve prescribed dose of Pancrex powder, using measuring spoon provided in 10-15mL of water. Administer the solution down the enteral tube within one hour (preferably immediately) and flush the line as per usual procedures.

**Notes**

Feeds should be paused whilst the Pancrex V solution is administered and re-started once the feeding tube has been flushed with water post-administration of the Pancrex V dose.

Do NOT give Pancrex V during feed breaks.

If patient already established on other pancreatic enzyme products e.g. Creon, discuss with pharmacist regarding administration details and/or dietitian for whether a switch to Pancrex would be appropriate.

Once patients are able to take pancreatic supplements orally – switch pancrex V powder to Creon capsules.

References


Requesting and prescribing Parenteral Nutrition within Adult Critical Care

Monday- Friday during working hours:

Parenteral Nutrition (PN) may be ordered daily Monday to Friday up until 1pm from Pharmacy Sterile Production Unit (SPU) located on A floor east block, QMC campus. On a Friday PN should also be ordered for Saturday, Sunday and Bank holidays. The critical care dietitian should always be contacted to assess the patient for the appropriateness of PN and to calculate the patient’s nutritional requirements. The dietitian will review the patient daily during weekdays and prescribe PN on the NUH PN prescription chart. A critical care doctor will be asked to sign the prescription. Once signed, the critical care dietitian will take (QMC Campus) or fax the prescription to SPU (City campus). If sent via the tube system SPU must be phoned so they know to expect the PN charts. The ward will be rung to collect the PN from SPU (QMC) or Inpatients Pharmacy (City) when it is ready. This is usually between 4-5.30pm.

Any unused PN should be kept in the fridge as it may be possible to reuse it if PN is discontinued. The critical care pharmacist should be informed during working hours if this has occurred.

City Campus Only

SPU need to be contacted after the PN prescription chart has been faxed to obtain the batch number for the PN. This needs to be endorsed on the PN chart in the pharmacy batch number box. Either the dietitian, pharmacist or nurse looking after the patient must then take the PN chart to Inpatients Pharmacy.

Out of hours PN requests:

The decision to commence PN is NEVER an emergency. It is envisaged that in the majority of cases PN requests will be able to wait until the next working day, so a dietitian can assess the patient.

Flowchart for requesting PN

Weekdays out of hours

There is no facility to request PN out of hours between Monday to Friday. The critical care dietitian must be contacted on the next weekday morning to assess the patient and order PN.
Weekends and bank holidays

Over a weekend or bank holiday, where there is a clinical need to start PN for a critical care patient, the weekend working pharmacists must be contacted for a supply between 10am-1pm. The decision to initiate PN must be made by a critical care consultant.

If PN is needed for a patient at QMC campus the pharmacist based in Surgical Satellite Pharmacy, west block E floor should be contacted (Ext 65798). The PN will not be supplied until after 4pm when the satellite pharmacy closes. At City campus if PN is needed the weekend pharmacists in Inpatients Pharmacy (Ext 55983) need to be contacted. If workload permits a supply will be made before pharmacy closes at 1pm. If this is not possible the ward will be contacted after 4pm.

The agreed out of hours PN bag is a SmofKabiven 8 Electrolyte Free bag which contains NO electrolytes and no additions of water or fat soluble vitamins or trace elements. Out of hours the contents of the bag cannot be changed and therefore emergency PN may not be appropriate for every patient.

Patients for whom this bag of PN may not be appropriate include:
- Very low BMI e.g. below 16kg/ m². May still be appropriate as a reduced starting rate
- Patients with a good nutritional status prior to critical care admission. NICE/ EPANIC trial guidance would suggest a period of up to 7 days may be acceptable to attempt to establish enteral feeding.

Prescribing procedure for weekends and bank holidays:
- A critical care consultant assesses the patient and after discussion with the patients parent team (as appropriate) approves use of PN.
- A doctor must prescribe PN on a PN prescription chart. This will be a SmofKabiven 8g Nitrogen, Electrolyte Free bag with no additions. The doctor must specify the infusion rate (see PN rate information below) and sign the chart. See appendix 1 for how to complete the PN prescription chart.
- All patients initiating TPN out of hours should receive IV Pabrinex one pair (1+2) daily for 3 days.
- A doctor must complete the out of hours PN checklist (appendix 2).
- The PN chart and checklist must be sent to Surgical Satellite Pharmacy (QMC) or Inpatients Pharmacy (City) between 10am-1pm. There is no facility for PN to be ordered after 1pm.
- PN must only be given via a central line, ideally via a dedicated lumen.
- Due to infection control and sterility issues the PN bag and giving set must be changed every 24 hours, even if there is still some left in the previous day’s bag.
- If PN is ordered from pharmacy on a Saturday, Sundays bag should also be ordered and both bags will be supplied from pharmacy. During a bank holiday weekend enough PN should be prescribed and supplied to last until the next working day.
- Any patients started on PN during a weekend must be highlighted to the critical care dietitian on the next working day.

Out of hours SmofKabiven 8 EF infusion rate:
- Usual infusion rate is 41ml/hr this will infuse the whole PN bag over the 24 hour period. However, if patient BMI is less than 16kg/m² and PN is still necessary, then consider a starting infusion rate of 20ml/hr and maintaining this rate until patient assessed by dietitian.
- If there is a decision to start nasogastric (NG) feed then the rate of PN infusion should be reduced by the NG feed rate e.g. NG feed at 30ml/hr, reduce PN by 30ml/hr.
Monitoring:

Re-feeding syndrome is the severe fluid and electrolyte shifts and other related metabolic complications that occur in malnourished patients when initiating support. Please refer to the NUH Guideline Refeeding Guideline for information – http://nuhnet/nuh_documents/Guidelines/1881.pdf

All patients commenced on PN out of hours should have their U+E’s, calcium, phosphate and magnesium levels checked at 12 hours then daily thereafter. Any drop in levels below the normal range in particular phosphate should be corrected as per the critical care guidelines as the bag is electrolyte free.

Blood glucose should be closely monitored as per the critical care guideline.

Spiked or leaking bags:

During weekends or bank holidays if a PN bag for a patient who is already established on PN is spiked, or found to be leaking, then it may be possible for the on-call pharmacist to supply a replacement SmofKabiven 8 EF bag with no additions. A SmofKabiven 8 EF bag is the only PN bag that can be supplied in this scenario. Pharmacy should be contacted between 10am-1pm to arrange a supply. A doctor will need to prescribe a plain SmofKabiven 8 EF PN bag with no additions on the PN prescription chart before a replacement bag can be supplied (see appendix 1). The bag should be started at the maximum rate of 41ml/hr or at the same rate as the previous PN was running if lower than 41ml/hr

There may be another PN bag in the fridge that can be used before a replacement bag can be issued the next day, e.g. if Saturdays bag is leaking a bag for Sunday may in the PN fridge. The on-call pharmacist should still be contacted via switchboard to highlight the need for a replacement bag the following day. If this replacement occurs on Sunday morning and is prepared by experienced sterile production staff it may be possible to continue the patients same PN regime but with no additions or vitamins or trace elements.

This facility is not available out of hours during weekdays where the dietitian or critical care pharmacist should be contacted first thing the next morning and informed of the spiked/leaking bag.

Useful contacts:

<table>
<thead>
<tr>
<th>Placing PN orders weekdays</th>
<th>Confirming PN orders weekdays</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fax to: 0115 970 9744</td>
<td>Telephone number (SPU main area): 63043</td>
</tr>
<tr>
<td>Alternative fax number (to use if main number unobtainable): 0115 970 9780</td>
<td></td>
</tr>
<tr>
<td>Confirming PN orders weekdays</td>
<td>Requesting PN weekends and bank holidays</td>
</tr>
<tr>
<td>Requesting PN weekends and bank holidays</td>
<td>QMC campus telephone: 65798 Ask to speak to weekend pharmacist</td>
</tr>
<tr>
<td>City campus telephone: 55983 Ask to speak to weekend pharmacist</td>
<td></td>
</tr>
</tbody>
</table>
# How to fill in PN prescription chart for out of hours PN

<table>
<thead>
<tr>
<th>Date:</th>
<th>01/01</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of line</td>
<td>Central</td>
</tr>
<tr>
<td>Regimen number</td>
<td>SmoFKabiven 8 EF</td>
</tr>
<tr>
<td>Na (mmol)</td>
<td>0</td>
</tr>
<tr>
<td>K (mmol)</td>
<td>0</td>
</tr>
<tr>
<td>Ca (mmol)</td>
<td>0</td>
</tr>
<tr>
<td>Mg (mmol)</td>
<td>0</td>
</tr>
<tr>
<td>PO₄ (mmol)</td>
<td>2.8</td>
</tr>
<tr>
<td>Fat soluble vitamins</td>
<td>Nil</td>
</tr>
<tr>
<td>Water soluble vitamins</td>
<td>Nil</td>
</tr>
<tr>
<td>Trace elements</td>
<td>Nil</td>
</tr>
<tr>
<td>Other additions</td>
<td>Nil</td>
</tr>
<tr>
<td>Volume to be infused</td>
<td>9360 (ml/hr) x 24 (Max 966ml)</td>
</tr>
<tr>
<td>Duration of infusion (per 24 hours)</td>
<td>24hrs</td>
</tr>
<tr>
<td>Infusion rate (ml/hr)</td>
<td>41 ml/hr, but see notes above</td>
</tr>
<tr>
<td>Prescribers signature</td>
<td>Dr X</td>
</tr>
<tr>
<td>Contact details</td>
<td>Bleep</td>
</tr>
<tr>
<td>Pharmacy batch number</td>
<td></td>
</tr>
</tbody>
</table>

## Appendix 2:
Checklist for the initiation of PN within Adult Critical Care at weekends and bank holidays

**Available between 10am to 1pm only**

1. **Indication for TPN**
2. Does the patient have a contraindication to enteral feed?
   - If No consider pro-kinetics, post-pyloric tubes, sedation holds and aggressively pursue the enteral feeding policy.
   - If Yes go to next question.

3. Does a contraindication to enteral feeding exist which will be present and sustained for >72 hours?
   - If No use enteral route.
   - If Yes go to next question.

4. Has the patient had low electrolytes replaced (e.g. replacement of potassium, magnesium and phosphate as per critical care guidelines)
   - If No initiate replacement.
   - If Yes go to next question.

5. Does the patient have a dedicated lumen of a central line for PN delivery?
   - If No reconsider appropriateness of PN vs. central line insertion.
   - If Yes go to point 6.

6. Prescribe PN on PN prescription chart. Once the prescription and checklist have been filled in a PN bag can be requested from Outpatients Pharmacy (QMC) or Inpatients Pharmacy (City).

7. Ensure indication for PN is reviewed every 24 hours in the medical notes and that monitoring is carried out as per guideline.

<table>
<thead>
<tr>
<th>Prescribers signature:</th>
<th>Date:</th>
<th>Pharmacists Signature:</th>
<th>Date:</th>
</tr>
</thead>
</table>

Name of Consultant requesting initiation of PN if different from the prescriber:

*Completed forms should be kept by the supplying pharmacist out of hours and then given to the critical care pharmacist on the next working day.*
Guideline for the Use of Phenytoin within Critical Care

**Indication**
Convulsive Status Epilepticus (CSE), uncontrolled fitting & prevention and treatment of seizures associated with head trauma and neurosurgery.

**Presentation:** 5ml amps, containing phenytoin sodium 50mg/ml.

**Prescribing** Loading dose: Typically 20mg/kg - max 2 grams (2000mg).

IV infusion in sodium chloride 0.9% administered at a max rate of 50mg/min. A critical care guideline exists for management of CSE. Doses are calculated on an individual basis using actual body weight – to a max of 2g.

*Continuous BP and ECG monitoring is essential for all IV infusions. The standard rate on the DERS infusion device for the loading dose is 50mg/minute. If bradycardia or hypotension occur's reduce infusion rate. However, ensure the infusion is still complete within one hour of preparation.*

For dosing in grossly overweight and obese patients please contact a Critical Care Pharmacist, or out of hours the on-call Pharmacist via switchboard.

**Administration of Loading Dose**
Administration must be as an infusion using a dedicated central or large peripheral line.

**Method 1** NEAT in a syringe pump. No filter needed.

**Method 2** Diluted as per table below.

ALL diluted phenytoin infusions must be administered via a 0.2 micron in-line filter (located in the omnicells).

<table>
<thead>
<tr>
<th>Loading dose of Phenytoin</th>
<th>Administration Instruction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 1g</td>
<td>In 100ml NaCl 0.9% infuse via the DERS programme on the pump.</td>
</tr>
<tr>
<td>Greater than 1g (to a maximum of 2g)</td>
<td>In 250ml NaCl 0.9% infuse via the DERS programme on the pump</td>
</tr>
</tbody>
</table>
Maintenance dose
Usual starting dose **300mg once daily.** (Dosage based on 3-4 mg/kg /day).
Given enterally or by IV infusion. With ECG monitoring.
Alternatively 100mg IV three times a day
Start 6 hours after the loading dose. IV preferred within critical care due to interactions with 24 hour NG feeds and presence of continuous ECG and BP monitoring.

Administration of maintenance dose for 300mg and above:

**Method 1** NEAT in a syringe pump. No filter needed.
**OR**
**Method 2** via a volumetric pump in 50ml sodium chloride 0.9% using a 0.2micron filter.

Both methods MUST be infused using the pumps DERs programme which is set to standardly run over 15 mins.
Phenytoin is **incompatible with Glucose 5%.**

Administration of maintenance doses of 100mg:

Slow IV bolus over TWO minutes (max rate 50mg /min)

It is important to flush before and after administration with Sodium Chloride 0.9% to avoid local venous irritation and clear dead space from the given set *(see page 9 small volume infusion flushes).*

Infusions must be **completed within 1 hour of preparation** Closely observe during infusion to ensure no crystal formation. If crystallization occurs stop infusion immediately and contact prescriber.

Giving sets (Carefusion Code 60033E), with in-built 0.2 micron filters for use with Alaris CareFusion volumetric pumps. Available from materials management in boxes of 50 (NHS Supply Chain code FKA321)

**Side effects:** Arrhythmias, skin rashes, blood dyscrasias, altered LFTs - particularly raised GGT.
**Side effects associated with high levels/toxicity**
Nystagmus, ataxia, nausea, slurred speech, drowsiness and confusion.

Administration via Enteral Tubes
Patients routinely stay on IV therapy whilst receiving 24 hour naso-gastric feeding.
Enteral administration is therefore, **not recommended** on Adult Critical Care due to poor absorption, interactions with NG feed.
If NG administration is thought to be clinically necessary, please discuss with a critical care pharmacist and dietician to ensure a 4 hour feed break. Consider switching to NG administration prior to discharge from critical care.

**Monitoring**

**The usual therapeutic range is 10 - 20 mg/L.** For some patients, levels outside this range may be appropriate. It takes 7 days after initiation or dosage adjustment to reach steady state concentrations. Daily levels may be indicated in unstable patients within 12-24 hours following the load.

Note that phenytoin expresses non-linear pharmacokinetics, where changes in levels are not proportional to alterations in dosing. Phenytoin is highly bound to albumin. For patients with low albumin a correction needs to be made to the level to account for an increased free active proportion of phenytoin. In critically ill patients this calculation only acts as a guide in the context of the patients clinical condition due to rapidly changing albumin levels.

Corrected level \( mg/L = \frac{\text{Measured level (mg/L)}}{(0.9 \times \text{Measured serum albumin (g/l)) + 0.1}} \)

Within Critical Care, NOTIS now reports “corrected” phenytoin levels, where the result is adjusted for the patient’s albumin. In patients with low albumin, it is important that the corrected level is recorded, and where this is not reported on NOTIS, that the above calculation is performed. Extra care must be taken to ensure the correct result is used.

For patients with low albumin levels on CVVH or in AKI please contact your Ward Pharmacist for advice on calculating accurate phenytoin levels.

**References:**
PATIENT GROUP DIRECTIVES (PGDs)

The following PGD’s are relevant to practice within Adult Critical Care Areas at NUH:

- Administration of Drugs During Anaphylactic Reactions in Adults
- Glucose
- IV Fluids
- Naloxone
- Oxygen
- Paracetamol

A full list of PGD’s in use within NUH are available on the Non Medical Prescribing, Administration and Supply Group (NMPAS) website, this can be found via the link below or by searching NMPAS in the search box on the NUH intranet.

http://nuhnet/medical_director/committees/medicines_management_committee/Pages/patient_group_directions.aspx

To ensure the most up to date documents are referred to, please use the address above to access current, authorised PGDs.
## Trustwide Patient Group Direction

### Administration of Drugs during Anaphylactic reactions in Adults

1. **Clinical situation to which this patient group direction applies**

<table>
<thead>
<tr>
<th></th>
<th>Definition of the clinical condition/situation</th>
</tr>
</thead>
<tbody>
<tr>
<td>i</td>
<td>Anaphylaxis is a hypersensitivity reaction mediated by immunoglobulin E (IgE) anaphylactoid reaction which is similar but does not depend on hypersensitivity. This could be following:</td>
</tr>
<tr>
<td></td>
<td>administration of an intravenous drug, or</td>
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<td></td>
<td>blood transfusion, or</td>
</tr>
<tr>
<td></td>
<td>ingestion or inhalation of other substances eg insect bites/stings, peanuts, drugs by any route.</td>
</tr>
<tr>
<td></td>
<td>This causes any or all systemic symptoms such as:</td>
</tr>
<tr>
<td></td>
<td>hypotension, tachycardia, cardiovascular collapse, or death</td>
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<tr>
<td></td>
<td>bronchospasm and wheeze,</td>
</tr>
<tr>
<td></td>
<td>angio-oedema and stridor,</td>
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<tr>
<td></td>
<td>These symptoms may occur with or without rash, nausea, vomiting, diarrhoea or abdominal pain.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Inclusion criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>ii</td>
<td>Adults over the age of 16 years whose condition suggests a general hypersensitivity/anaphylactic reaction following drug administration, blood transfusion, insect bite/sting or following ingestion or inhalation of other substances.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Exclusion criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>iii</td>
<td>Children under the age of 16 years.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Actions for patients excluded from treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>iv</td>
<td>If the patient is under 16 years of age, contact medical staff.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Actions for patients not wishing to receive care</th>
</tr>
</thead>
<tbody>
<tr>
<td>v</td>
<td>Not applicable</td>
</tr>
</tbody>
</table>

2. **Characteristics of staff authorised to administer/supply medicines under this patient group direction**

<table>
<thead>
<tr>
<th></th>
<th>Professional qualifications required</th>
</tr>
</thead>
<tbody>
<tr>
<td>i</td>
<td>Registered nurse (RN) The registered nurse must possess valid registration with the Nursing and Midwifery Council (NMC) Physiotherapist with registration with HCPC</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Specialist qualifications, training and experience relevant to the clinical condition and the medicines used</th>
</tr>
</thead>
<tbody>
<tr>
<td>ii &amp; iii</td>
<td>In addition to the above qualifications the health care professional acting under this direction must:</td>
</tr>
<tr>
<td></td>
<td>have successfully completed the Trust Anaphylaxis Education Package and reviewed their knowledge on an annual basis</td>
</tr>
<tr>
<td></td>
<td>have up-to-date basic life support skills</td>
</tr>
<tr>
<td></td>
<td>For physiotherapists they must be authorised by NUH to give joint injections</td>
</tr>
<tr>
<td></td>
<td>All Health Care Professionals undertaking the ILS course will have an anaphylaxis scenario demonstrated on the course.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Requirements for continued training</th>
</tr>
</thead>
<tbody>
<tr>
<td>iv</td>
<td>All nurses acting under this direction will be expected to maintain knowledge and competence as defined by the NMC Code (2015). All Allied Health Professionals acting under this direction will be expected to maintain knowledge and competence evidenced in their CPD record if CPD is a requirement for their continued registration.</td>
</tr>
</tbody>
</table>
3. Description of medicines available in the Patient Group Direction

i. Supply of medicines
No medications will be supplied to the patient for self-administration under this direction

The following medications may be administered in accordance with guidance given in the Trust anaphylaxis education package and UK Resuscitation Council advice.

<table>
<thead>
<tr>
<th>(ii) Drug to be administered</th>
<th>(iii) Legal status</th>
<th>(iv) Dose to be given</th>
<th>(v) Route</th>
<th>(vi) Frequency</th>
<th>(vii) Total dose/number of treatments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adrenaline (if pulse present)</td>
<td>POM</td>
<td>0.5ml 1:1000 (0.5mg)</td>
<td>IM</td>
<td>Repeat once after 5 minutes</td>
<td>2 doses only</td>
</tr>
<tr>
<td>Adrenaline (if no pulse) (Follow cardiac arrest procedures)</td>
<td>POM</td>
<td>10mls 1:10,000 (1mg)</td>
<td>IV</td>
<td>Once only</td>
<td>1 dose only followed by sodium chloride 0.9% flush</td>
</tr>
<tr>
<td>Hydrocortisone</td>
<td>POM</td>
<td>200mgs</td>
<td>IM or slow IV</td>
<td>Once only</td>
<td>1 dose only</td>
</tr>
<tr>
<td>Chlorphenamine</td>
<td>POM</td>
<td>10mgs</td>
<td>IM or slow IV</td>
<td>Once only</td>
<td>1 dose only</td>
</tr>
<tr>
<td>Sodium chloride 0.9% flush</td>
<td>POM</td>
<td>20ml</td>
<td>IV flush</td>
<td>4 doses only</td>
<td>4 doses only</td>
</tr>
<tr>
<td>Hartmanns / Plasmalyte OR if not available Sodium chloride 0.9%</td>
<td>POM</td>
<td>1000ml</td>
<td>IV</td>
<td>Once only fast infusion</td>
<td>One dose only</td>
</tr>
<tr>
<td>Epipen (for community use only)</td>
<td>POM</td>
<td>300 microgrammes</td>
<td>IM</td>
<td>Repeat dose after 5 minutes</td>
<td>2 doses only</td>
</tr>
<tr>
<td>Oxygen</td>
<td>GSL</td>
<td>15litres via non re-breathing mask</td>
<td>inhalation</td>
<td>Once only</td>
<td>Once only</td>
</tr>
</tbody>
</table>

POM = Prescription Only Medicine  
GSL = General sales list
Viii | Information about follow-up treatment  
--- | ---  
All conscious patients should be monitored closely and encouraged to report any changes in condition including:  
- feeling odd,  
- faint or disorientated,  
- rash or itching  
- wheeziness  
- difficulty in breathing.  
- tongue swelling

ix | Advice to the patient before or after treatment  
--- | ---  
Consideration should be given to the information patients require following successful treatment of anaphylaxis and a member of the medical team must be involved in this process.
Manufacturer's product information should be available for patients who wish to read it.

x | Instructions for identifying and managing future possible adverse outcomes  
--- | ---  
Any adverse reactions should be recorded in the patient's medical and nursing notes, including type of reaction, timings, effects on the patient, actions taken, outcomes and measures taken to avoid a similar problem in the future. Serious or unusual suspected reactions must be reported on a 'Suspected Adverse Drug Reactions' form (Yellow card) and submitted to the Medicines and Healthcare Regulatory Authority.
If a patient is treated under this PGD an untoward critical incident form should be completed.

xi | Referral for medical advice  
--- | ---  
The patient should be referred to medical staff when an anaphylactic reaction is identified.
If the patient collapses the cardiac arrest team should be called.
All patients who suffer an anaphylactic reaction should be referred to an allergy clinic.

xii | Facilities and supplies that should be available  
--- | ---  
Adrenaline 1 in 1000 (1mg in 1ml), hydrocortisone and chlorphenamine will be stored in a tamper evident plastic anaphylaxis box on the resuscitation trolley.
Adrenaline 1 in 10,000 (1mg in 10ml) prefilled syringes will be stored in the blue cardiac arrest box on the resuscitation trolley.

xiii | Treatment records  
--- | ---  
The nurse will record the treatment according to this group direction;  
- On the once only /patient group direction section of the patient’s current drug prescription card.  
- In the patient’s nursing and medical notes

xiv | Side-effects, contra-indications and any relevant concurrent medication considerations  
--- | ---  
Avoid concurrent administration of adrenaline in the same line as sodium bicarbonate. Adrenaline is only stable in an acid medium.

If patients are taking beta-blockers, the effect on im adrenaline 0.5mg may be reduced and these patients should be monitored closely for response to the first dose. A second dose of i.m. Adrenaline should be given within 5 minutes if their condition remains unchanged or worsens.

If patients are taking high doses of tricyclic antidepressants e.g. 175mg amitriptyline in 24 hours, these have the potential to enhance the effect of i.m. adrenaline. However the effect is clinically insignificant.
Patient Group Direction Specialist Support Directorate

The Emergency Treatment of Severe Hypoglycaemia (blood glucose level less than 2.2mmol/L) in Adult Critical Care and Major Trauma Patients.

1. Clinical situation to which this patient group direction applies

   i  Definition of the clinical condition/situation
   Hypoglycaemia is classified as a blood glucose level of less than 4mmol/L. Symptoms of hypoglycaemia may be difficult to spot in sedated patients but they include; loss of consciousness, sudden sweating, sudden tachycardia and sudden hypotension unresponsive to inotropes. The definition of severe hypoglycaemia is a blood glucose level of less than 2.2mmol/L.

   ii  Inclusion criteria
   All patients over 16 years of age on adult critical care wards (Surgical HDU (E12), Major Trauma (C30), Medical HDU, AICU QMC, CCD City and Cardiac ICU) with a blood glucose level of less than 2.2mmol/L. The initial blood glucose must be re-checked prior to administration of glucose to ensure it is a correct reading.

   iii  Exclusion criteria
   Any patient that does not satisfy the inclusion criteria.

   iv  Actions for patients excluded from treatment
   Not applicable.

   v  Actions for patients not wishing to receive care
   Not applicable.

2. Characteristics of staff authorised to administer/supply medicines under this patient group direction

   i  Professional qualifications required
   The registered nurse (RN) must possess valid registration with the Nursing and Midwifery Council (NMC).

   ii  Specialist qualifications, training and experience relevant to the clinical condition and the medicines used
   Any nurse working in critical care must in addition to 2(i) above:
   - Have successfully completed the NUH intravenous drug administration package and local course
   - Understand the meaning of a PGD
   - Have completed a current immediate life support course
   - Have knowledge of the current national (http://www.diabetes.nhs.uk/our_publications/) and local hypoglycaemia guidelines

   iv  Requirements for continued training
   All nurses under this direction will be expected to maintain knowledge and competence as expected of the NMC Code of Conduct (2015). All nurses acting under this direction will be expected to maintain knowledge and competence. Following breaks in work attendance of 6 months or greater 2ii and 2iii above would be revalidated and have a period of mentoring initiated.
3. Description of medicines available in the Patient Group Direction

i. No medications will be supplied to the patient for self-administration under this direction

<table>
<thead>
<tr>
<th>(ii) Drug to be administered</th>
<th>(iii) Legal status</th>
<th>(iv) Dose to be given</th>
<th>(v) Route</th>
<th>(vi) Frequency</th>
<th>(vii) Total dose/number of treatments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glucose 20% infusion (100ml bottle)</td>
<td>POM</td>
<td>100ml (bottle) run over 10 minutes</td>
<td>IV Central line preferred.</td>
<td>Repeat once if the blood glucose levels are less than 4mmol/L after 15 minutes</td>
<td>2x100mls</td>
</tr>
</tbody>
</table>

viii Information about follow-up treatment
Blood glucose levels should be rechecked to make sure that the first level was correct prior to administration of glucose. The nurse MUST immediately stop any insulin infusions that might be running. A laboratory blood glucose sample should be sent to the lab for analysis. Monitor the patient for signs of phlebitis if a large peripheral vein is used to administer glucose. The total dose of 200mls of 20% glucose does not represent the maximum dose and further glucose may be prescribed if required. The nurse should ensure that vital sign monitoring is maintained as appropriate to the patient’s condition. If the level of consciousness is unsatisfactory and a doctor is not present an arrest call should be placed (2222).

ix Advice to the patient before or after treatment
Consideration should be given to informing the patient of the hypoglycaemic event and the treatment given, if appropriate.

x Instructions for identifying and managing future possible adverse outcomes.
Any adverse reactions should be recorded in the patient’s medical and nursing notes, including type of reaction, timings, effects on the patient, actions taken, outcomes and measures taken to avoid a similar problem in the future. Serious or unusual suspected reactions must be reported on a ‘Suspected Adverse Drug Reactions’ form (Yellow card) and submitted to the Medicines and Healthcare Regulatory Authority.
If a patient is treated under this PGD an untoward/critical incident form should be completed.

xi Referral for medical advice
All patients requiring management under this PGD must be immediately referred to a medical practitioner for review.

xii Facilities and supplies that should be available
20% glucose 100ml bottles are available on all adult wards in the trust.

xiii Treatment records
The nurse will record treatment and outcomes;
- On the PGD section of the patients medicine chart, and in the patients nursing notes.
The following information must be included in the medical notes;
- Date, medicine name, dose and time of administration
- Signature, designation and printed name.

xiv Special considerations relating to the administration of concurrent medicines
Doctor to review insulin prescription prior to re-initiating. Side effects of glucose are; Hyperglycaemia, venous irritation and thrombophelbitis (due to the low pH of the hypertonic fluid).
### Trustwide Patient Group Direction

Administration of Intravenous fluids to adults in an emergency

<table>
<thead>
<tr>
<th>1. Clinical situation to which this patient group direction applies</th>
</tr>
</thead>
</table>
| **i** *Definition of the clinical condition/situation*  
Patient with symptomatic hypotension which *may* include the following  
- a systolic blood pressure less than 90mmHg,  
- reduced urine output<0.5ml/Kg/hr,  
- tachycardia > 100 beats per minute,  
- increased respiratory rate  
- a fall in level of consciousness. |
| **ii** *Inclusion criteria*  
Patients over 16 years old |
| **iii** *Exclusion criteria*  
- Patients under 16 years old  
- Patients with a diagnosed and documented terminal illness with clear instructions in the medical notes stating not for any further escalation in treatment |
| **iv** *Actions for patients excluded from treatment*  
- Medical staff to be contacted immediately for instruction on the treatment of excluded patients.  
- Document findings and action taken in patient’s medical notes. |
| **v** *Actions for patients not wishing to receive care*  
- Medical staff to be called urgently.  
- Patients to be encouraged to have treatment  
- Patient decision to be noted in their nursing notes/ care pathway |

<table>
<thead>
<tr>
<th>2. Characteristics of staff authorised to administer/supply medicines under this patient group direction</th>
</tr>
</thead>
</table>
| **i** *Professional qualifications required*  
A nurse must possess valid registration with the Nursing and Midwifery Council (NMC) |
| **ii & iii** *Specialist qualifications, training and experience relevant to the clinical condition and the medicines used*  
Any person administering fluids under this direction must in addition to 2(i) above  
- Have completed  
  - Acute Illness Management (AIM) training (or ALERT) OR  
  - Acute Care skills Course OR  
  - Have a valid Resuscitation Council Immediate Life Support Course (ILS)  
  - And  
  - Has been assessed as competent in the Administration of Intravenous therapy in accordance with the Working in New Ways Guidance NUH.  
  - And  
  - Be familiar with CCOT early warning score for assessment of an acutely unwell patient. |
| **iv** *Requirements for continued training*  
All nurses acting under this direction will be expected to maintain knowledge and competence as defined by the NMC Code (2015)  
Those completing role expansion package(s) will be required to update their learning as specified in the Working in New Ways policy |
3. **Description of medicines available in the Patient Group Direction**

**Supply of medicines**
No medicines will be supplied to patients for self-administration under this group direction.

<table>
<thead>
<tr>
<th>(ii) Drug to be administered</th>
<th>(iii) Legal status</th>
<th>(iv) Dose to be given</th>
<th>(v) Route</th>
<th>(vi) Frequency</th>
<th>(vii) Total dose/number of treatments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium Lactate Compound Intravenous Solution (e.g. Hartmanns or plasmalyte 128)</td>
<td>POM</td>
<td>500mls or 250mls if known cardiac condition</td>
<td>IV administer within 5 minutes</td>
<td>Further 500ml to be administered after 5 minutes if no or little improvement.</td>
<td>Two doses Up to 1000mls</td>
</tr>
<tr>
<td>(If Hartmanns or plasmalyte 128 not available Sodium Chloride 0.9% Intravenous solution)</td>
<td>POM</td>
<td>500mls or 250mls if known cardiac condition</td>
<td>IV administer within 5 minutes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>viii</td>
<td>Information about treatment and follow up</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----</td>
<td>------------------------------------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>A responsible medical practitioner / Hospital at Night coordinator (out of hours) should be contacted to review the patient.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>A full set of observations as per EWS escalation plan should be completed after each bolus and then every 15 minutes for 1 hour then if observations are stable reassess using the EWS policy.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>A Wide bore giving set (blood set found on resuscitation trolley) will allow more rapid administration of the fluid than a solution set.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Compound Sodium Lactate is incompatible with many drug solutions so should not be administered into the same cannula as drug containing solutions.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ix</th>
<th>Advice to the patient before or after treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>The patient will be informed verbally (where possible) that they required fluid treatment. The infusion is being given to reverse this drop in blood pressure.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>x</th>
<th>Instructions for identifying and managing future possible adverse outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Stay with patient and monitor closely the effects of IV fluids to ensure the benefit is realised.</td>
</tr>
<tr>
<td></td>
<td>Monitor observations as per EWS Trust policy Use a pulse oximeter to monitor saturations.</td>
</tr>
<tr>
<td></td>
<td>Seek medical advice immediately in the event of an adverse outcome.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>xi</th>
<th>Referral for medical advice</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Medical staff to be informed about requirement of IV fluids and requested to review the patient immediately. (Within half an hour).</td>
</tr>
<tr>
<td></td>
<td>• If the patient condition does not improve or deteriorates and the doctor has not yet arrived to review the patient – the resuscitation team should be called 2222.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>xii</th>
<th>Facilities and supplies that should be available</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>The following should be available for use</td>
</tr>
<tr>
<td></td>
<td>Emergency resuscitation equipment should be available and access to a pulse oximeter.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>xiii</th>
<th>Treatment records</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>The administration of the IV fluids should be recorded on the PGD/Once Only section of patient drug chart, signed by the qualified nurse/midwife administrating the IV fluids and second checked by a nurse/midwife</td>
</tr>
<tr>
<td></td>
<td>Fluid administration be recorded on the observation chart or the medical records.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>xiv</th>
<th>Special considerations relating to the administration of concurrent medicines</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Potentially fluid overload with or without the development of heart failure-caution in patients with cardiac disease (heart failure) of renal impairment.</td>
</tr>
<tr>
<td></td>
<td>For further information on side effects and contra-indications please refer to the electronic data sheet compendium (<a href="http://www.emc.medicines.org.uk">www.emc.medicines.org.uk</a>)</td>
</tr>
</tbody>
</table>
Patient Group Direction Trust wide
Administration of Naloxone by Registered Nurses to Adult Patients

1. **Clinical situation to which this patient group direction applies**

   i. **Definition of the clinical condition/situation**
      - Patients with respiratory rate of less than 8bpm caused by one or more of the following opioid drugs: Morphine, Diamorphine, Fentanyl, Alfentanil, Oxycodone, Codeine, Tramadol, Pethidine, Buprenorphine or Hydromorphone which have been administered to relieve pain.

      **AND**
      - Who are not easily rousable (P or U on AVPU).

      In all cases a doctor should be called urgently.

   ii. **Inclusion criteria**
      - All patients over the age of 16 years old in the event of respiratory depression caused by opiates which have been administered to relieve pain **and** who are not easily rousable (P or U on AVPU).

   iii. **Exclusion criteria**
      - Any patient who does not satisfy the inclusion criteria.

   iv. **Actions for patients excluded from treatment**
      - Not applicable.

   v. **Actions for patients not wishing to receive care**
      - Not applicable.

2. **Characteristics of staff authorised to administer/supply medicines under this patient group direction**

   i. **Professional qualification required**
      - Registered nurse (RN).
      - The registered nurse must possess valid registration with the Nursing and Midwifery Council (NMC).

   ii. **Specialist qualifications, training and experience relevant to the clinical condition and the medicines used**
      - Any nurse administering Naloxone under this direction, must:
        a) Have successfully completed the NUH WINW Intravenous drug administration package
        b) Understand the meaning of a PGD
        c) Have completed current Immediate life support course
        d) Have knowledge of the current national and local resuscitation guidelines

   iv. **Requirements for continued training**
      - All nurses acting under this direction will be expected to maintain knowledge and competence as defined by the NMC Code (2015).

3. **Description of medicines available in the Patient Group Direction**

   **Supply of medicines**
   - No medicines will be supplied to patients for self-administration under this group direction.
<table>
<thead>
<tr>
<th>(ii) Drug to be administered</th>
<th>(iii) Legal status</th>
<th>(iv) Dose to be given</th>
<th>(v) Route</th>
<th>(vi) Frequency</th>
<th>(vii) Total dose/number of treatments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Naloxone Hydrochloride</td>
<td>POM</td>
<td>100 micrograms</td>
<td>Intravenous injection 400 micrograms diluted to 4ml with 0.9% sodium chloride</td>
<td>The dose should be titrated, 100 micrograms as a slow IV bolus over 30 seconds and repeated every 2 minutes until a satisfactory rise in respiratory rate is achieved whilst aiming to maintain adequate analgesia.</td>
<td>800 micrograms</td>
</tr>
</tbody>
</table>

**viii Information about follow-up treatment**

The nurse should ensure that continuous cardiac and vital sign monitoring are maintained as appropriate to the patient's condition. If the respiratory rate does not improve to greater than 8 breaths per minute or level of analgesia and/or consciousness is unsatisfactory and a doctor is not present an arrest call should be placed 2222.

The total dose of 800 micrograms does not represent the maximum dose for this drug and the doctor may give further injections or an infusion.

If the patient is receiving an opiate via an Epidural or a Patient controlled analgesia (PCA) device this should be discontinued and medical assistance sought immediately.

**ix Advice to the patient before or after treatment**

Consideration should be given to informing the patient of the event following successful reversal of respiratory depression. A medical practitioner should be involved in this process.

**x Instructions for identifying and managing future possible adverse outcomes**

Adverse reactions to administration should be recorded in the medical and nursing notes, including type of reaction, effects on patient, action taken, outcomes and measures taken to avoid a similar problem in the future.

**xi Referral for medical advice**

All patients requiring management under this group direction must be immediately referred to a medical practitioner for review.

**xii Facilities and supplies that should be available**

Prior to instigating this Group Direction the nurse should ensure that the resuscitation trolley with drugs and equipment is immediately available if required.

**xiii Treatment records**

The nurse will record treatment and outcomes

a) on the “Patient Group Directions” section of the patient's Medicine Prescription and Administration Record

b) in the patient's nursing and medical notes

c) Complete DATIX form

The following information must be included in the medical notes:

- Date, dose and time of administration
- Signature, designation and printed name

**xiv Special considerations relating to the administration of concurrent medicines**

Doctor to review prescription for opiates on the treatment chart
Trust wide Patient Group Direction
Administration of Paracetamol by Midwives and Nurses in adults

1. Clinical situation to which this patient group direction applies

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>i</td>
<td>Definition of the clinical condition/situation</td>
</tr>
<tr>
<td></td>
<td>All adult patients, aged 16 years and over, who fulfil the inclusion criteria below.</td>
</tr>
<tr>
<td>ii</td>
<td>Inclusion criteria</td>
</tr>
<tr>
<td></td>
<td>Administration of paracetamol will apply in the following situations:</td>
</tr>
<tr>
<td></td>
<td>- patients experiencing mild to moderate pain</td>
</tr>
<tr>
<td></td>
<td>- patients with a pyrexia (see exclusion criteria)</td>
</tr>
<tr>
<td></td>
<td>For Paracetamol suppositories, patients who fulfil the above criteria and in addition</td>
</tr>
<tr>
<td></td>
<td>- are requested to receive “nil by mouth” because of risk of aspiration</td>
</tr>
<tr>
<td></td>
<td>- have vomited after receiving oral Paracetamol</td>
</tr>
<tr>
<td></td>
<td>- cannot swallow or their ability to swallow requires investigation (unless administration is via a feeding tube)</td>
</tr>
<tr>
<td>iii</td>
<td>Exclusion criteria</td>
</tr>
<tr>
<td></td>
<td>Patients will not be treated under this direction if they:</td>
</tr>
<tr>
<td></td>
<td>- refuse treatment</td>
</tr>
<tr>
<td></td>
<td>- are under 16 years</td>
</tr>
<tr>
<td></td>
<td>- are allergic to paracetamol</td>
</tr>
<tr>
<td></td>
<td>- have suffered a previous adverse reaction to paracetamol</td>
</tr>
<tr>
<td></td>
<td>- have taken another preparation containing paracetamol within the last 4 hours</td>
</tr>
<tr>
<td></td>
<td>- are currently being treated for paracetamol overdose</td>
</tr>
<tr>
<td></td>
<td>- have a history of liver disease or are at risk of hepatocellular toxicity</td>
</tr>
<tr>
<td></td>
<td>- have pain known to be unresponsive to paracetamol</td>
</tr>
<tr>
<td></td>
<td>- are being treated for malignant disease and their neutrophil count is unknown</td>
</tr>
<tr>
<td></td>
<td>- known to be neutropenic and not on intravenous antibiotics</td>
</tr>
<tr>
<td></td>
<td>- patients in advanced labour</td>
</tr>
<tr>
<td></td>
<td>In addition for suppositories</td>
</tr>
<tr>
<td></td>
<td>- have had recent bowel surgery</td>
</tr>
<tr>
<td></td>
<td>- have inflammatory bowel disease</td>
</tr>
<tr>
<td></td>
<td>Caution</td>
</tr>
<tr>
<td></td>
<td>If the patient has a weight of less than 50kg maximum dose should not exceed 15mg /kg 4 times per day OR 20mg / kg three times per day</td>
</tr>
<tr>
<td>iv</td>
<td>Actions for patients excluded from treatment</td>
</tr>
<tr>
<td></td>
<td>Patients excluded for any reason will be referred to a medical practitioner for further assessment and advice.</td>
</tr>
<tr>
<td>v</td>
<td>Actions for patients not wishing to receive care</td>
</tr>
<tr>
<td></td>
<td>Patients who do not wish to be treated under this direction will be given further explanations regarding the benefits of this preparation. If they still choose to withhold consent medical staff will be informed and their advice sought.</td>
</tr>
</tbody>
</table>

2. Characteristics of staff authorised to administer/supply medicines under this patient group direction

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>i</td>
<td>Professional qualifications required</td>
</tr>
<tr>
<td></td>
<td>The registered nurse / midwife must possess valid registration with the Nursing and Midwifery Council (NMC).</td>
</tr>
</tbody>
</table>
3. Description of medicines available in the Patient Group Direction

Supply of medicines

No medicines will be supplied to patients for self-administration under this group direction.

<table>
<thead>
<tr>
<th>(ii) Drug to be administered</th>
<th>(iii) Legal status</th>
<th>(iv) Dose to be given</th>
<th>(v) Route</th>
<th>(vi) Frequency</th>
<th>(vii) Total dose/ number of treatments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paracetamol</td>
<td>POM</td>
<td>0.5-1 gram</td>
<td>Oral or By feeding tube</td>
<td>4-6 hourly</td>
<td>4gram in 24hrs Maximum of 4 treatments. Patients must be reviewed by a doctor if they need ongoing analgesia *See below</td>
</tr>
<tr>
<td>In the form of: Tablets or Caplets or Soluble tablets</td>
<td>(if from a pack of more than 32)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paracetamol suppositories</td>
<td>P</td>
<td>0.5 - 1 gram</td>
<td>Rectal</td>
<td>4-6 hourly</td>
<td>4gram in 24 hours Maximum of 4 treatments Patients must be reviewed by a doctor if they need ongoing analgesia *See below</td>
</tr>
</tbody>
</table>

If the patient has a weight of less than 50kg maximum dose should not exceed 15mg /kg 4 times per day OR 20mg / kg three times per day

viii Information about follow-up treatment

Patients should be advised to inform the nurse or midwife
- if their symptoms do not improve following administration of paracetamol
- if they develop any side effects
- if a repeat dose is needed after four hours

ix Advice to the patient before or after treatment

The patient data sheet will be available. The nurse or midwife will be conversant with side effects.

x Instructions for identifying and managing future possible adverse outcomes

Adverse outcomes are rare with paracetamol. Any patient developing problems should be reviewed by a doctor and the episode should be fully documented.

xi Referral for medical advice

Where the nurse or midwife requires advice on the suitability of treatment, management of problems or feels the patient’s management is outside his/her sphere of competence, support must be sought from medical staff.
### Facilities and supplies that should be available

A stock of paracetamol tablets and suppositories, as specified in this direction, will be stored according to local policy in a locked cupboard.

### Treatment records

The nurse or midwife will record treatment according to this direction;

- [a] in the Patient Group Direction/Once only section of the patient’s Medicine Prescription and Administration Record

  or if this record is not available

- [b] in the medical notes stating all the information which would normally be recorded in on the Medicine Prescription and Administration Record

### Special considerations relating to the administration of concurrent medicines

Paracetamol may be less effective if administered within two hours of a dose of cholestyramine.
GUIDELINE FOR PHOSPHATE REPLACEMENT IN ADULT CRITICAL CARE

Background:
Critically ill patients are at increased risk of hypophosphataemia due to potential malnutrition/refeeding risk, gastrointestinal losses and catecholamine and insulin administration. Phosphate is predominantly an intracellular ion and in the form of Adenosine Triphosphate (ATP) is an important source of cell energy; deficiency can lead to tissue hypoxia and dysfunction as well as slow weaning from mechanical ventilation.

Normal adult phosphate range = 0.8-1.45 mmol/L  Aim for Serum phosphate >0.8mmol/L

<table>
<thead>
<tr>
<th>Severity of Hypophosphataemia</th>
<th>Serum Phosphate Level (mmol/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mild</td>
<td>0.65-0.79</td>
</tr>
<tr>
<td>Moderate</td>
<td>0.32-0.64</td>
</tr>
<tr>
<td>Severe</td>
<td>&lt;0.32</td>
</tr>
</tbody>
</table>

Symptoms usually occur when serum phosphate falls below 0.32 mmol/L

Signs and Symptoms of Hypophosphataemia:
- Generalised muscle weakness, myopathy, respiratory muscle weakness
- Confusion, irritability, hallucinations, somnolence, seizures
- Decreased cardiac contractility, cardiomyopathy, arrhythmias

Phosphate replacement:

Enteral administration

First line for all patients with mild hypophosphataemia ≥0.6mmol/L unless patient is high risk due to co-morbidities or not absorbing then treat with intravenous as below.

Phosphate-Sandoz 2 tablets THREE times a day or Two WHEN REQUIRED at 6 hourly intervals.

Intravenous infusion

If Phosphate < 0.6mmol or patient classed at risk as below.

40mmol Potassium Acid (Dihydrogen) Phosphate IV infusion over 6 hours (pre-printed prescription) via CENTRAL VENOUS ACCESS ONLY.

For the 40mmol dose discard 10ml from the 50ml Potassium acid (dihydrogen) vial. As it is classed as a controlled drug – the 10ml should be wasted at the Omnicell cabinet at the time of issue from the cabinet.

If CENTRAL VENOUS ACCESS not available:

9mmol Potassium Acid (Dihydrogen) Phosphate in 259mL Sodium Chloride 0.9% over 6-12 hours. Can be infused quicker if clinically indicated.
Presentations:

1. 50mmol/50mL vials of Potassium Acid (Dihydrogen) Phosphate (contains 50mmol Potassium)

2. 20mmol/20mL vials of Sodium Glycerophosphate  RESERVED for patients with hyperkalaemia

3. 9mmol Potassium Acid (Dihydrogen) Phosphate in 259mL Sodium Chloride 0.9% (pre-made bags from pharmacy)-  RESERVED for patients with only peripheral access

At risk patients:

- Chronic alcoholism, vitamin D deficiency, hyperparathyroidism, patients at risk of re-feeding syndrome.

Cautions/Contra-indications:

-Baseline potassium level of >4.8mmol/L (injection contains potassium)

-Renal impairment or patients on CVVH where it is interrupted as phosphate and potassium will re-start to accumulate.

-Hypocalcaemia – correct prior to replacing phosphate.

Side-effects:

-Diarrhoea/GI upset (most common with enteral route), hypocalcaemia

References:


NUH Guideline for treatment of hypophosphataemia in adults March 2016
Clinical guidelines are guidelines only. The interpretation and application of clinical guidelines will remain the responsibility of the individual clinician. If in doubt contact a senior colleague or expert. Caution is advised when using guidelines after a review date. This guideline has been registered with the Mid Trent Critical Care Network.

Background
Patients within adult critical care commonly require repeated concentrated potassium infusions in order to maintain their serum potassium levels within the therapeutic range. Critically ill patients have an increased risk of cardiac side effects in the presence of normal low serum potassium levels. For this reason the desired serum potassium level in this patient group is usually between 4.0 – 5.0 mmol/L (Additional caution required in: renal failure, patients receiving a thiopentone infusion or those being actively cooled due to the risk of rebound hyperkalaemia.)

Aim of this local policy is to ensure the safe administration of potassium infusions by nursing staff in adult critical care units.

This policy recognises that:
- The prescriber is responsible for the potassium chloride prescription
- The nurse is responsible for following the policy to ensure the safe administration of intravenous potassium chloride in accordance with the NMC Standards for Medicines Management April 2010 and the current edition of the individual unit medicines administration policies, which must be followed at all times.

Patient Group Included
- Patients aged 16 years or over on Adult Critical Care units in the Mid-Trent Critical Care Network
- In an area where there is the facility to receive continuous cardiac monitoring (ECG)
- MUST have CENTRAL VENOUS ACCESS and have been prescribed a concentrated potassium infusion

Patient Group Excluded
- Patients aged under 16 years

Health Professionals authorised to administer drugs under this policy:
- Registered Nurses (RGN) who have successfully completed the Intravenous Drug Administration Competency relevant to the unit in which they are working.
- Registered Nurses (RGN) who have successfully completed the Questions on Potassium Infusions (Appendix 1)

Indication
Serum Potassium <4.0 mmol/L as determined by arterial or venous blood gas or by serum blood. (Unless a thiopentone infusion is running.)
Prescribing of Potassium
Treatment Principles:
• Intravenous treatment of hypokalaemia with potassium chloride should only be prescribed when the enteral route is unavailable, where the patient is symptomatic or where enteral administration will not achieve the required elevation of serum potassium within a clinically acceptable timeframe.
• Pre-prepared potassium infusions MUST be used where available.
• All potassium infusions MUST be administered via an infusion pump to ensure the rate of infusion is controlled.
• All patients receiving potassium should have serum potassium measured at least once daily.

Hypokalaemia prophylaxis within Adult Critical Care (K+ 4.0-5.0 mmol/L)
• Patients who do not have vomiting, diarrhoea, high GI losses and are absorbing standard nutrition potassium supplementation should not be needed to maintain serum potassium levels within the specified limits.
• Some medications – e.g. salbutamol, furosemide and insulin - may predispose to hypokalaemia, therefore patients on these medications should be managed with early potassium supplementation.
• If absorbing enteral potassium preparations should be prescribed regularly/when required for these patients. (e.g. Sando K two 3 to 4 times a day). Sando K contains 12mmol potassium per tablet.

Hypokalaemia treatment within Adult Critical Care (K+ 3.9 mmol/L or less)
• Hypokalaemia within Adult Critical Care can be associated with dysrhythmias, ileus and muscle weakness, and the consequences of this may be more severe in the presence of other electrolyte imbalances.
• Concentrated potassium syringe of 50mmol in 50ml should be administered to the patient via a central venous catheter at a rate of 12.5mmol/hr. Maximum 6 infusions (300mmol) in 24 hours by nurse led administration. This does not represent the maximum daily dose and further doses maybe prescribed at the doctor's discretion.
• Sando K 2 3-4 times a day regularly or when required can be co-administered to the patient if the enteral route is available.

NOTE: When clinically indicated potassium may be prescribed to run at a faster rate than specified in this policy. (No alterations should be made to pre-printed prescriptions a new prescription MUST be written) The usual maximum rate is 20mmol/hour but can be increased to 40mmol/hour with continuous ECG monitoring in EMERGENCY situations.
1. Check blood potassium level $< 4.0 \text{mmol/L}$. If the potassium level is between $3.0 \text{ – 3.9mmol/L}$ a potassium infusion may be initiated in accordance with the local policy.

If the blood potassium level is $< 3.0 \text{mmol/L}$ contact the doctor and any advice given should be documented in the nursing notes prior to initiating the potassium infusion. *If the decision is made to administer potassium at a different rate to the one specified in this policy nurse led administration must not occur. A separate prescription must be written* (see note above for maximum rates)

2. Ensure the prescription for concentrated potassium infusions on the intravenous infusion chart has been signed and dated by a doctor.

3. Check the patient’s prescription chart to ensure that the 300mmol of potassium allowed in 24 hours for nurse led administration has not or will not be exceeded.

4. Check the patient’s prescription chart for other concurrently running potassium containing infusions. (Refer to Table 1 for potassium containing infusions that may be co-administered with a concentrated potassium infusion.) The total rate of potassium administration must not exceed 20mmol per hour following the local agreement.

5. Record the potassium level on the IV infusion chart prior to the start of the infusion.

6. Prepare and label one Potassium Chloride Syringe (if unit does not use prefilled syringes). Enter the patient’s name and prescription details in the unit’s potassium register (electronically recorded in units with omnicells.)

7. Confirm the patency of the central line by aspirating the lumen prior to commencing the concentrated potassium infusion

8. Obtain a second check from an eligible practitioner who must ensure consistency with the prescription for name of *drug, dose, concentration, route, rate of administration* and that a correct entry has been made in the register. The second check MUST take place at the bedside and both practitioners must check the rate and route of infusion before signing the prescription. **NB this infusion MUST run via a CENTRAL VENOUS CATHETER ONLY.**

9. Following an audit undertaken at NUH it is **NO LONGER** necessary to routinely check serum potassium levels by blood gas measurements at 2 hours into the infusion. The whole syringe may run uninterrupted over the four hours. The exceptions to this rule are:

- Patients with Acute Kidney Injury that have also been anuric (urine output $< 10 \text{ml/hr}$) for 4 hours or longer at the time of starting the potassium infusion.

- Where continuous renal replacement therapy running in a patient is interrupted (usually CVVH, CVVHDF). In this instant, the potassium infusion should be discontinued and blood gas potassium measured within the next two hours to guide further therapy.

**NB:** *This local agreement does not preclude checking blood gases at 2 hours if required for another clinical reason.*

Any potassium syringes not completely infused must be discarded after **FOUR** hours. Do not leave a syringe connected to the patient ‘just in case’ further potassium infusions are needed.
<table>
<thead>
<tr>
<th>Infusion</th>
<th>Potassium Concentration</th>
<th>Infusion rate</th>
<th>Route</th>
<th>Indication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potassium Acid (Dihydrogen)</td>
<td>Contains 1mmol potassium per ml (Neat Injection)</td>
<td>Varying rates according to local policies. Do NOT exceed a combined potassium infusion rate of 20mmol per hour</td>
<td>Central Line</td>
<td>Hypophosphataemia. If Serum phosphate is above 0.5mmol/L complete potassium infusion prior to starting the phosphate infusion, check potassium levels before starting phosphate replacement</td>
</tr>
<tr>
<td>Phosphate 13.6%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crystalloids</td>
<td>Up to 40mmol/L</td>
<td>0-100ml/hr</td>
<td>Peripheral or Central Line</td>
<td>Fluid replacement</td>
</tr>
<tr>
<td>(Sodium Chloride 0.9%, Glucose 5%, Glucose 4%/Sodium Chloride 0.18%, Glucose 2.5%/Sodium Chloride 0.9%, Compound sodium lactate solution-Hartmann’s)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fluids for renal replacement therapies</td>
<td>4mmol/L (equivalent to 20mmol in 5Litres)</td>
<td>Variable</td>
<td>Renal Replacement Circuit via Vascath</td>
<td>CVVH / CVVHD / CVVHDF</td>
</tr>
<tr>
<td>Prismasol 4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TPN</td>
<td>Variable</td>
<td>Variable</td>
<td>Central Line (Check with Pharmacy if Peripheral route is required)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Measure K⁺ from an arterial blood sample. (if no arterial access a venous sample can be used) Check other serum electrolytes and replace as needed.

K⁺ < 4mmol/l (Unless thiopentone infusion is running)

K⁺ < 3mmol/l

Contact Dr and document advice given in nursing notes

K⁺ < 3.0-3.9mmol/l

Check Potassium prescription has been signed by a Dr.

Nurse led administration of concentrated potassium. Administer 50mmol/50ml syringe at 12.5ml/hr via a central line. If phosphate levels low consider giving IV phosphate to replace both potassium & phosphate

Patient with AKI + anuric / urine output<10ml/hr for> 4 hours or on Renal replacement therapy (CVVH)

Recheck Serum Potassium in 4- 8 hours

YES

Check Potassium levels at two hours into the infusion

Less than 4.8mmol/L Complete remaining 2 hours of the infusion.

4.8mmol/L or more OR CVVH interrupted STOP INFUSION. Recheck in 2 hours

NO

Run whole syringe for 4 hours

Ensure Sando Ktablets are prescribed and use potassium containing maintenance fluids to maintain serum potassium levels as appropriate.

K⁺ > 4mmol/l but < 5.0mmol/l

K⁺ > 5.0 mmol/l

Contact Dr and document advice given in nursing notes

Concentrated Potassium – Key Points

- Store in CD cupboard, and order via CD book.
- Administer via a central line ONLY.
- Administer at a rate of 12.5ml/hr.
- Maximum of 6 syringes can be used in 24 hours by nurse-led administration.
- Prescribed on pre-printed Adult Critical Care Infusion Chart.
- Discard Syringe after 4 hours.
### Document control/ supporting information for this clinical document

<table>
<thead>
<tr>
<th>Title:</th>
<th>Mid-trent critical care network Potassium Replacement in Adult Critical Care</th>
</tr>
</thead>
<tbody>
<tr>
<td>Version number:</td>
<td>4</td>
</tr>
<tr>
<td>Approval:</td>
<td>v. Approved by: MTCCN Clinical Group Approval Date: May 2015</td>
</tr>
<tr>
<td>Issue date:</td>
<td>December 2016 (amendment agreed with MTCCN June 2016)</td>
</tr>
<tr>
<td>Review date:</td>
<td>Do not use after December 2018</td>
</tr>
<tr>
<td>Job title of author responsible for the document/ author name:</td>
<td>MTCCN Pharmacy Group</td>
</tr>
<tr>
<td>Superseded document(s):</td>
<td>Version 3 May 2015</td>
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</tbody>
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### Version History and Practice Changes/ Amendments

<table>
<thead>
<tr>
<th>Issue Date</th>
<th>Version</th>
<th>Amendments from version 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>May 2015</td>
<td>3</td>
<td>• Removed the routine need for 2 hour blood gas potassium monitoring with two exceptions described in the document.</td>
</tr>
</tbody>
</table>

### Distribution (Circulation):

• Critical Care units within the Mid-Trent Critical Care Network
Clinical guidelines are guidelines only. The interpretation and application of clinical guidelines will remain the responsibility of the individual clinician. If in doubt contact a senior colleague or expert. Caution is advised when using guidelines after a review date. This guideline has been registered with the Mid Trent Critical Care Network.

Prokinetic guideline summary flowchart:

1. **Gastric aspirates >400ml on 2 occasions or vomiting (and bowel obstruction excluded).**
   - Prescribe metoclopramide 10mg TDS (5mg TDS if <45kg) and erythromycin 250mg BD. Repeat gastric aspirates every 6 hours.
   - **Gastric aspirates <400ml after 72 hours.**
     - Stop prokinetics when at full feeding rate for 24 hours. Prokinetics should not be continued for more than 7 days.
   - **Gastric aspirates still >400ml after 72 hours.**
     - Patient has not responded to prokinetic treatment, stop metoclopramide and erythromycin. Consider alternative feeding route such as jejunal feeding.
Background:
The provision of enteral nutrition in critically ill patients is associated with fewer septic complications, decreased stress ulceration and bacterial translocation across intestinal mucosa, decreased catabolic response to injury and improved wound healing. However, decreased gastrointestinal motility due to use of sedation and catecholamines, electrolyte abnormalities, sepsis, head injury, abdominal surgery and hyperglycaemia often accompany critical illness. This may result in inability to achieve adequate levels of enteral feeding, reduced absorption of drugs and may increase risk of gastroesophageal reflux with subsequent aspiration and nosocomial pneumonia. The use of prokinetic agents has been shown to increase gastrointestinal motility. Metoclopramide increases gastric emptying by increasing the oesophageal sphincter tone, improving gastric tone and peristalsis, relaxation of the pyloric sphincter and augmentation of the duodenal peristalsis. Erythromycin at low doses has motilin receptor agonist properties thus producing a prokinetic effect by promoting gastric and duodenal peristalsis.

Indication:
Intolerance to gastric feeding with 6 hourly nasogastric aspirates >400ml (unless ileus suspected) on two occasions or vomiting. See summary flowchart.

Prokinetic therapy should only be used in conjunction with a feeding protocol. Feeding rates may need to be reduced if intolerance to enteral feeding occurs.

Dosage:
- Always give prokinetics intravenously (IV) in critical care.
- Metoclopramide 10mg (5mg if < 45kg) three times daily IV as slow bolus injection over at least 3 minutes.
- Erythromycin 250mg twice daily IV in 50-100mL of Sodium Chloride 0.9% over 30 mins.
- Discontinue prokinetics once feed tolerated at desired rate for 24 hours.
- Stop if watery diarrhoea develops.
- If the patient does not respond to prokinetics in the first few days they are unlikely to respond and they should be stopped. Therefore if the patient is still intolerant of feed after 3 days of treatment the prokinetics should be stopped and alternate feeding routes such as jejunal feeding considered.
- For patients that do respond to prokinetics there is limited evidence for continuing them beyond 7 days as treatment failure (tachyphylaxis) has been shown to occur and there is an increased risk of the development of side-effects. If the clinical decision is made to continue metoclopramide beyond 5 days this must be documented in the medical notes.

The use of metoclopramide and erythromycin as prokinetics is an off label indication.

NB- Due to the cost of erythromycin £10.98 (excluding VAT) per vial please review the continuing need for prokinetics daily. (NUH price Jan 2015)

Renal Impairment:
No dose adjustment of metoclopramide is required in renal impairment, but there is an increased risk of extrapyramidal side-effects in severe renal impairment. Consider reducing to either 10mg BD or 5mg TDS if this is a concern.
As erythromycin is being used at a prokinetic dose lower than the BNF recommended therapeutic dose no dose adjustment is necessary for erythromycin in renal impairment.
Contraindications:
- Hypersensitivity to metoclopramide or erythromycin.
- Gastrointestinal obstruction, perforation or haemorrhage.
- Phaeochromocytoma.
- Avoid metoclopramide use in patients with Parkinson’s disease as it can antagonise the effect of anti-parkinsonian drug therapy.
- Do not use metoclopramide in patients that are epileptic and actively fitting, because metoclopramide reduces seizure threshold. In a stable epileptic patient metoclopramide can be used with caution.
- Do not prescribe erythromycin if the patient is already prescribed clarithromycin for treatment of an infection.

Cautions:
- MHRA advice limits the use of metoclopramide to 5 days at a total daily dose of 30mg due to the risk of neurological adverse effects. If the clinical decision is made to continue metoclopramide beyond 5 days (up to the 7 days maximum) this must be documented in the medical notes.
- Caution in patients under 20 years: increased risk of extrapyramidal symptoms with metoclopramide.
- Due to an increased risk of cardiac arrhythmias (QT prolongation) at full treatment doses IV Erythromycin should be used with caution in patients receiving other drugs that prolong the QT interval. Consider monitoring QT interval by doing a 12 lead ECG every few days if this is a concern.

Side Effects:
Prokinetic agents general- abdominal pain, bloating, watery diarrhoea.
Erythromycin- urticaria, rashes, cholestatic jaundice, pancreatitis, cardiac arrhythmias.
Metoclopramide- extrapyramidal effects, hyperprolactinaemia, anxiety, confusion, cardiac arrhythmias.

Interactions:
- Erythromycin has a number of significant drug interactions that need consideration before prescribing due to inhibition of the cytochrome P450 system.
- Erythromycin at full treatment doses may also increase the QT interval and should be used with caution in combination with other drugs causing QT prolongation for example amiodarone, quetiapine, citalopram and fluconazole.
- Increased risk of myopathy when erythromycin is given with statins, withhold statins for the duration of erythromycin treatment.

References:
**DOCUMENT CONTROL**

<table>
<thead>
<tr>
<th>Version:</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Changes to this version:</strong></td>
<td>Prokinetics to be commenced if gastric aspirate volume &gt;400ml on 2 occasions instead of &gt;250ml as per NUH feeding guidance 2013. Prokinetics to be stopped if no effect after 72 hours instead of continuing as per critical care journal article 2014. Metoclopramide to be dose reduced if patient &lt;45kg instead of &lt;60kg as per MTCCN Pharmacist group consensus. Erythromycin volume changed from 100ml to 50-100ml as per NUH IV guide. Cost of erythromycin vial added as per NUH data. Renal dosing amended as per current renal drug handbook. Metoclopramide use in Parkinson’s disease changed from a caution to a contraindication as per BNF. Metoclopramide use contraindicated in actively fitting patients as per BNF. Statement added about not using erythromycin as a prokinetic while on clarithromycin as per usual clinical practice. Metoclopramide use beyond 5 days added as a caution as per MHRA guidance 2013. Caution about erythromycin not to be used in combination with amiodarone removed as does not reflect current clinical practice. Wording changed regarding erythromycin prolonging the QT interval (<em>'full dose' added</em>) and added a caution in combination with other drugs that prolong the QT. Advice about monitoring 12 lead ECGs if concerned added. Interaction with suxamethonium removed as not relevant in critical care.</td>
</tr>
</tbody>
</table>

| Date: | March 2015 |
| Date ratified: | May 2015 |
| Date due for review: | May 2017 Do not use after May 2018 |
| Approval: | MTCCN Clinical Group |
| Author: | MTCCN Pharmacy Group |
| Consultation: | MTCCN Pharmacy Group Critical Care Nursing Staff MTCCN |
| Distribution: | Critical Care Units within the Mid Trent Critical Care Network |
GUIDELINE FOR THE INITIATION OF RIVAROXABAN WITHIN ADULT CRITICAL CARE POST ALTEPLASE VENOUS THROMBOLYSIS WITH A CONCOMITANT CONTINUOUS HEPARIN INFUSION

Background:

Rivaroxaban is an oral anticoagulant that works as a direct factor-Xa inhibitor. Unlike warfarin, there is no need to monitor INR and full anticoagulation is established as soon as the drug is absorbed. There is no requirement for treatment dose low molecular weight heparin (enoxaparin) cover or prolonged continuation of continuous heparin infusions.

Indication:

Prevention of reoccurrence of Deep Vein Thrombosis (DVT) post INTRAVENOUS thrombolysis in patients unsuitable for warfarin as per Nottinghamshire formulary http://www.nottinghamshireformulary.nhs.uk/

The use post ARTERIAL thrombolysis is an unlicensed, off label use of Rivaroxaban and must be approved by a consultant haematologist prior to prescribing.

Presentation:

10mg, 15mg and 20mg tablets.

Tablets may be crushed and dispersed for administration down enteral tubes.

Dose:

Initial dose: 15mg twice a day for 21 days (supplied by NUH)

Maintenance dose: 20mg daily for 3-6 months (supplied by GP)

Once patients have been successfully thrombolysed and alteplase stopped the first dose of rivaroxaban should be given and the continuous heparin infusion continued for a further 2 hours then STOPPED. (Peak serum concentrations of rivaroxaban are achieved 2 to 4 hours after oral dose).

Dosing in renal impairment:

Mild impairment (CrCl 50-80ml/min): no adjustment necessary.

In both moderate (30-49ml/min) and severe (15-29ml/min) impairment: Normal initial dose for the first 21 days then a maintenance dose of 20 mg once daily is recommended. A reduction of the dose from 20 mg once daily to 15 mg once daily should be considered if the patient’s assessed risk for bleeding outweighs the risk for recurrent DVT and PE. The manufacturers advise plasma concentrations are significantly increased in severe impairment <30ml/min. Seek haematology advice.

CrCl<15ml/min: avoid use.
Contra-indications to use:

- Current or recent gastrointestinal ulcer or known oesophageal varices
- Recent brain/spinal/ophthalmic surgery or injury
- Vascular aneurysms
- Hepatic disease associated with coagulopathies. Cirrhotic patients, Childs Pugh B and C.

Side-effects include:

- Bleeding risk, bruising, haematoma
- LFT derangements – check baseline LFTS prior to starting treatment.
- Dizziness, headache, syncope
- Tachycardia, Hypotension
- Gastrointestinal disturbances including: constipation, diarrhoea, vomiting.

Ensure all patients newly started on Rivaroxaban receive a patient alert card and are counselled about potential side effects and action to be taken if bleeding occurs.

Invasive procedures and elective surgical intervention:

Stop Rivaroxaban at least 24 hours before the intervention. Bleeding risk needs to be assessed by the clinician performing the procedure. For emergency surgery refer to the NUH guidelines for patients receiving Rivaroxaban requiring emergency surgery or treatment for haemorrhage. (Available via the NUH formulary link).

References:

GUIDELINE FOR THE USE OF STRESS ULCER PROPHYLAXIS AND GASTRO-PROTECTION

Adult Critical Care

Clinical guidelines are guidelines only. The interpretation and application of clinical guidelines will remain the responsibility of the individual clinician. If in doubt contact a senior colleague or expert. Caution is advised when using guidelines after a review date. This guideline has been registered with the Mid Trent Critical Care Network.

ON ADMISSION Mechanically ventilated or Nil By Mouth (NBM) patients:
Prescribe IV Proton Pump Inhibitor (PPI) or H₂ receptor antagonist according to local protocol.

Exceptions:
- Known or suspected GI (gastrointestinal) bleed - follow local guideline for PPI treatment e.g. continuous PPI infusion.
- Total gastrectomy patients - no requirement for gastro-protection.
- C. difficile patients - H₂ receptor antagonist preferred or consider stopping gastro-protection if indicated.

Once patient established on full enteral feed rate and has been absorbing (minimal aspirates) for >24 hours switch to enteral PPI or H₂ receptor antagonist according to local protocol.

REVIEW NEED for gastro-protection once patient is off vasopressors and out of multi-organ failure (MOF) with no GI bleeding suspected.
Continue with enteral gastro-protection if:
- History of GI bleed or peptic ulcer disease.
- Burns, trauma or head injury patients.
- Coagulopathy or thrombocytopenia (platelets <100).
- Oesophagectomy patients.
- Dual antiplatelet agents.
- Prolonged steroid exposure.
- Currently prescribed NSAIDs.
- Pre-existing H₂ receptor antagonist or PPI use.

Consider continuing with enteral gastro-protection if:
- Prolonged critical care stay.
- Single antiplatelet agent.
- Organ transplant recipients.

STOP gastro-protection once the patient is eating and drinking normally OR patient leaves risk criteria above.

REGULAR REVIEW during critical care stay. If patient deteriorates clinically, stops absorbing, vomits or becomes NBM / Nil by NG re-prescribe IV gastro-protection.

REVIEW gastro-protection in all patients prior to leaving critical care and stop as appropriate.
<table>
<thead>
<tr>
<th>Version:</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Changes to this version:</td>
<td>NA</td>
</tr>
<tr>
<td>Date:</td>
<td>May 2016</td>
</tr>
<tr>
<td>Date ratified:</td>
<td>May 2016</td>
</tr>
<tr>
<td>Date due for review:</td>
<td>May 2019</td>
</tr>
<tr>
<td>Approval:</td>
<td>MTCCN Clinical Group</td>
</tr>
<tr>
<td>Author:</td>
<td>MTCCN Pharmacy Group. Dr Paul James, Critical Care Consultant NUH. Dr David Sperry, Critical Care Consultant NUH.</td>
</tr>
</tbody>
</table>
| Consultation: | MTCCN Pharmacy Group  
Critical Care Nursing Staff MTCCN |
| Distribution: | Critical Care Units within the Mid Trent Critical Care Network |
Therapeutic Drug Monitoring in Adults at NUH
(Trust guideline approved October 2016)

The aim of Therapeutic Drug Monitoring (TDM) is to provide information that assists in optimising therapy. In general, routine measurements are not required (exceptions include: lithium, some immunosuppressants, IV aminophylline and some antibiotics), but rather taken to resolve a specific clinical problem, e.g. inadequate response, signs of toxicity.

Appropriate and documented specimen collection time

When taking a level, the following must be considered to avoid misleading results:

1. For dosage adjustment guidance, sampling at ‘steady-state’ is essential (unless confirming toxicity) and thus four to five elimination half-lives must have elapsed since the last change of maintenance dose.
2. Samples must be taken at an appropriate time during a dose interval.

Interpretation of most results is made in relation to the therapeutic range but clinical decisions should not be based on drug concentrations alone. The range is only a guideline derived from a normal population and some patients will respond or exhibit toxicity outside the expected ranges. Concentrations can be affected by factors such as age, drug interactions, protein binding and drug metabolism. Also, liver and/or renal impairment may reduce clearance and increase the risk of toxicity, especially after a dose increase.

The following provides a guide to the most requested drug assays provided by the Department of Clinical Pathology (NUH):

- Drugs analysed daily are: carbamazepine, digoxin, lamotrigine, levetiracetam, lithium, phenytoin, theophylline and valproate*
- Ciclosporin and tacrolimus are analysed at City Campus every weekday; analysis on Saturdays may be arranged via consultant to consultant request - contact the City Campus duty biochemist on ext 59729 or bleep 780-7796.
- Antibiotic levels are analysed at NUH – see separate guideline for details of sampling and therapeutic ranges
- Other drugs are also analysed through NUH on request, e.g. mycophenolate, sirolimus

*Measurement of valproate levels is not a useful index of efficacy and therefore routine monitoring is unhelpful. Optimum dosage mainly determined by seizure control. Therapeutic range is not clearly defined.

If results for any drug are required urgently please telephone the laboratory first: Clinical advice line 70880 or 59729 or bleep 780-7796. Out of hours bleep the biochemistry lab technician.
<table>
<thead>
<tr>
<th>Drug</th>
<th>Therapeutic range</th>
<th>Number of days before steady state</th>
<th>Optimum sampling time</th>
<th>Common signs and symptoms of toxicity</th>
<th>Type of sample required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aminophylline Infusion</td>
<td>10 - 20mg/L (lower levels e.g. 5-15mg/L may be effective)</td>
<td>1-2</td>
<td>Loading dose: 1-2 hours after dose given. Maintenance infusion: 4 to 6 hours after starting infusion.</td>
<td>Nausea, vomiting, tachycardia, anorexia, arrhythmias, agitation</td>
<td>2mL Serum</td>
</tr>
<tr>
<td>Carbamazepine</td>
<td>4 - 12mg/L</td>
<td>2-5</td>
<td>Trough measurement before a dose</td>
<td>Nausea, vomiting, dizziness, visual disturbances, ataxia, headache</td>
<td>2mL Serum</td>
</tr>
<tr>
<td>Ciclosporin</td>
<td>Contact lab. Varies with indication</td>
<td>4</td>
<td>For renal transplant patients at NUH 2 hour post dose measurements (label clearly). For all other oral uses, take trough level or consult local guidelines. IV (twice daily dosing): trough level. IV (continuous infusion): anytime.</td>
<td>Nausea, vomiting, tremor, headache, altered taste, altered limb sensation, drowsiness, oedema, flushing, hypertension. Note, many drug interactions</td>
<td>3mL EDTA</td>
</tr>
<tr>
<td>Clozapine</td>
<td>350-600 micrograms/L</td>
<td>5</td>
<td>12 hours after dose</td>
<td>Drowsiness, delirium, tachycardia, hypersalivation, respiratory depression, orthostatic hypotension, nocturnal enuresis, seizures, constipation.</td>
<td>2mL Serum</td>
</tr>
<tr>
<td>Digoxin</td>
<td>0.5 – 2.0 micrograms/L (Heart failure: 0.5-1.0 micrograms/L)</td>
<td>7-14</td>
<td>Oral and IV: at least 6 hours after dose, trough measurement before a dose is preferred.</td>
<td>Anorexia, headache, nausea, vomiting, diarrhoea, visual disturbances, arrhythmias. Risk of toxicity increased by electrolyte disturbances, e.g. hypercalcaemia, hypokalaemia, hypomagnesaemia.</td>
<td>2mL Serum</td>
</tr>
<tr>
<td>Lamotrigine</td>
<td>2-15mg/L</td>
<td>5-7</td>
<td>Trough measurement before a dose</td>
<td>Nystagmus, ataxia, nausea, vomiting, drowsiness, dizziness.</td>
<td>2mL Serum</td>
</tr>
<tr>
<td>Levetiracetam</td>
<td>12-46mg/L (upper limit not established)</td>
<td>2</td>
<td>Trough measurement before a dose</td>
<td>Vomiting, sedation, agitation, drowsiness, respiratory depression.</td>
<td>2mL Serum</td>
</tr>
<tr>
<td>Lithium</td>
<td>0.4 - 1.0 mmol/L Target level determined by specialist. Refer to local guidelines. &gt;1.5 mmol/L indicates toxicity.</td>
<td>5</td>
<td>12 hours post dose</td>
<td>Coarse hand tremor, muscle twitching, vomiting, severe diarrhoea, muscle weakness, lethargy, drowsiness, blurred vision, dehydration, confusion, slurred speech, ataxia, paraesthesia, dysarthria, nystagmus, vertigo, tinnitus, restlessness, ashen grey appearance.</td>
<td>2mL Serum</td>
</tr>
<tr>
<td>Phenytoin</td>
<td>10 - 20mg/L</td>
<td>7</td>
<td>Oral: trough level. IV: at least 2 hours after end of infusion.</td>
<td>Ataxia, slurred speech, nystagmus, diplopia, lethargy.</td>
<td>2mL Serum</td>
</tr>
<tr>
<td>Tacrolimus</td>
<td>5 – 15 micrograms/L (depends on indication, refer to local guideline)</td>
<td>3</td>
<td>Trough measurement before a dose (depends on preparation, refer to local guideline)</td>
<td>Nausea, vomiting, tremor, infections, urticaria, nephrotoxicity. Note, many drug interactions</td>
<td>3mL EDTA</td>
</tr>
<tr>
<td>Theophylline (and aminophylline) Oral</td>
<td>10 - 20mg/L (lower levels e.g. 5-15mg/L may be effective)</td>
<td>2</td>
<td>4 to 6 hours after taking dose</td>
<td>Nausea, vomiting, tachycardia, anorexia, arrhythmias, agitation</td>
<td>2mL Serum</td>
</tr>
</tbody>
</table>
THIOPENTONE (THIOPENTAL SODIUM) GUIDELINE

Indications:
Thiopentone is used within Adult Critical Care for:
1. The management of status epilepticus
2. The management of refractory raised intracranial pressure (ICP)

Action
It is a barbiturate which is thought to act within the central nervous system (CNS) via the suppression of synaptic neurotransmission. As a consequence it leads to:
- A reduction in cerebral blood flow, cerebral blood volume, ICP, and cerebral oxygen consumption.
- A dose-dependent reduction in cardiac output, stroke volume and systemic vascular resistance.
- Dose-dependent respiratory depression. Thiopentone can provoke a degree of laryngospasm & bronchospasm.
- Decreased renal plasma flow and increased anti-diuretic hormone (ADH) secretion with a consequent decrease in urine output.
- A dose-dependent reduction in body temperature.

Presentation: A vial of freeze dried thiopental 500mg.

Prescribing:
A bolus of 1-3 mg/kg (maximum 500 mg) should be given followed by an infusion:

Management of Raised ICP:
- 1-5 mg/kg/hr increased to 8 mg/kg/hr if burst suppression on EEG/ CFAM not achieved, up to 12 mg/kg/hr has been used.
- Titrate carefully to avoid hypotension, maintaining cerebral perfusion pressure >60 mmHg

As an adjunct in the Management of Convulsive Disorders:
- 1-5 mg/kg/hr increased to 8 mg/kg/hr if burst suppression on EEG/ CFAM not achieved
- Continue for 12-24 hours post seizure control then consider weaning, by halving the dose every 2 hours.

In the obese patient, doses should be based on lean body weight

Contraindications:
Known hypersensitivity reaction to thiopentone or other barbiturates
Acute porphyria
Status asthmaticus
Upper airway obstruction who do not have a definitive airway (e.g. ETT/ tracheostomy)

Cautions:
Uncorrected hypovolaemia, hypotension or shock
Constrictive pericarditis or severe stenotic valvular disease- Cardiovascular depressant effects may exacerbate condition
Addison's disease, myxoedema
Severe anaemia
Severe renal/ hepatic impairment- Hypnotic effect may be prolonged or potentiated
Myasthenia gravis/ neuromuscular disorders- Respiratory depression may be prolonged
Common Side effects include:
Respiratory depression, laryngospasm/ bronchospasm, Hypotension & tachycardia, Myocardial depression, arrhythmias, Shivering & hypothermia, Decreased gut motility, Dermatitis/rash. Risk of tissue necrosis following extravasation of the drug. Hypokalaemia (during infusion) with risk of rebound hyperkalaemia on cessation of therapy – **potassium needs to be corrected to no more than 3.5 mmol/L while on Thiopentone infusion.**

For a full list of side effects please refer to the Summary of Product Characteristics (SPC) available via www.medicines.org.uk

**Monitoring:**
Patients on thiopentone infusions should have a cerebral function analysing monitor (CFAM) in-situ to allow appropriate titration of treatment.

**Preparation:**
1500 mg of thiopental sodium in 60 ml water for injections (25 mg/ml) delivered via a syringe driver via a **dedicated lumen** of a **central venous catheter.** Infusions must be discarded if they appear cloudy, or after **24 hours**
- STAT boluses of thiopentone may be given via a peripheral line

**References:**
IV VANCOMYCIN PRESCRIBING IN ADULT CRITICAL CARE

Indication:
Vancomycin is a glycopeptide antibiotic, used within NUH to treat:
- community-acquired pneumonia in patients with a risk of MRSA
- suspected staphylococcal sepsis in patients with a risk of MRSA
- suspected central venous catheter sepsis
- severe hospital-acquired pneumonia

Dosing:
To ensure that therapeutic levels of Vancomycin are obtained quickly loading doses are used within Critical Care, these are to be prescribed on the once only section of the drug chart. The loading dose is based on Actual body weight and is irrespective of renal function:

<table>
<thead>
<tr>
<th>Actual Body Weight</th>
<th>Dose and administration details</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;60kg</td>
<td>1g in 250ml NaCl 0.9% over 100 minutes</td>
</tr>
<tr>
<td>60-90kg</td>
<td>1.5g in 250ml NaCl 0.9% over 150 minutes</td>
</tr>
<tr>
<td>&gt;90kg</td>
<td>2g in 500ml NaCl 0.9% over 200 minutes</td>
</tr>
</tbody>
</table>

In fluid restricted patients doses of up to 1g may be diluted in a minimum of 100ml, and doses up to 2g can be diluted in 250ml of fluid and given via a CVC. (Run DERS on carefusion volumetric as Vancomycin via CVC)

A Vancomycin loading dose calculator is available on the antibiotic website- however please use caution in elderly patients or those with unstable renal function or AKI. Following the loading dose the timing and dose of the maintenance infusion is important as this takes into account the renal function of the patient. This maintenance dose should be prescribed 12-24 hours after the loading dose, See below:

Step 2 Maintenance dose:
Calculate creatinine clearance using calculator on antibiotic website do not use eGFR from NOTIS. For patients receiving CVVH discuss with critical care pharmacist/see critical care guide.

<table>
<thead>
<tr>
<th>Calculated creatinine clearance</th>
<th>Maintenance dose</th>
<th>Time after loading to start maintenance dose (hours)</th>
<th>Recommended infusion fluid for each dose</th>
<th>Advised duration of infusion for each dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oliguric, anuric or &lt;10ml/min</td>
<td>Check levels after 4-5 days. (48 hours if renal function improves) Redose with 1g once level &lt;15mg/L</td>
<td>Only once levels &lt;15mg/L</td>
<td>250ml</td>
<td>120min</td>
</tr>
<tr>
<td>10-19ml/min</td>
<td>500mg every 48 hours</td>
<td>48</td>
<td>100ml</td>
<td>60min</td>
</tr>
<tr>
<td>20-29ml/min</td>
<td>500mg OD</td>
<td>24</td>
<td>100ml</td>
<td>60min</td>
</tr>
<tr>
<td>30-39ml/min</td>
<td>750mg OD</td>
<td>24</td>
<td>250ml</td>
<td>75 min</td>
</tr>
<tr>
<td>40-54ml/min</td>
<td>500mg BD</td>
<td>12</td>
<td>100ml</td>
<td>60min</td>
</tr>
<tr>
<td>55-74ml/min</td>
<td>750mg BD</td>
<td>12</td>
<td>250ml</td>
<td>75min</td>
</tr>
<tr>
<td>75-89ml/min</td>
<td>1g BD</td>
<td>12</td>
<td>250ml</td>
<td>120min</td>
</tr>
<tr>
<td>90-110ml/min</td>
<td>1.25g BD</td>
<td>12</td>
<td>250ml</td>
<td>125min</td>
</tr>
<tr>
<td>&gt;110ml/min</td>
<td>1.5g BD*</td>
<td>12</td>
<td>500ml</td>
<td>180min</td>
</tr>
</tbody>
</table>

* Patients <45kg should be given a maximum starting dose of 1.25g BD
Vancomycin levels:
A pre-dose sample (gold top serum separator tubes (preferred) or red top) should be sent to Clinical Chemistry. Levels may be requested 24 hours a day, 7 days per week with results usually available within 2-3 hours. For details on how to complete the sample request form please refer to the antibiotic website.
In anuric/oliguric patients or those receiving renal replacement therapy a ‘level and wait’ should be endorsed pre 2nd dose.
In patients with poor renal function or poor urine output (<0.5ml/kg/hr) a ‘level and wait’ should be endorsed on the chart pre 3rd dose.
In patients with normal renal function and good urine output (>0.5ml/kg/hr) a ‘level and give’ can be endorsed on the chart pre 3rd or 4th dose.

THE LOADING DOSE IS CLASSED AS THE FIRST DOSE

Trough levels of 10-15mg/L are usually required, however following Microbiology advice occasionally levels of 15-20mg/L are needed.
Assuming that the levels have been taken at the right time- see Vancomycin Assays on the microbiology website- doses can be adjusted based on reported levels to achieve the desired serum concentration.

Please contact the Critical Care Pharmacist with any queries.

Side effects:
Ototoxicity and nephrotoxicity associated with high trough levels. Phlebitis. Rarely neutropenia, thrombocytopenia
Guideline for the Use of Vasopressin in Shock

**Background:**
Vasopressin (also known as anti-diuretic hormone, ADH) is an endogenous hormone with multiple physiological actions, directly or indirectly affecting plasma osmolality, haemostasis, haemodynamics and endocrine function. Argipressin is a pharmaceutical analogue of vasopressin.

**Indication:**
The principle use of argipressin in critical care is as a vasopressor in the event of the failure of traditional agents, such as noradrenaline, to maintain an adequate arterial blood pressure to maintain organ perfusion. It is commonly added to treatment when noradrenaline requirements are >0.5 microgram/kg/min.

**Cautions:**
Caution in patients with pre-existing cardiovascular disease especially of the coronary arteries. Cardiogenic or hypovolaemic shock. Vasopressin can prolong the QT interval therefore caution should be used if concurrent medication prescribed also has this effect

**Contra-indications:**
Contra-indicated in anaphylaxis or hypersensitivity to the drug or its components

**Presentation:**
Argipressin® (Pitressin) is supplied as 20 units in 1ml ampoules that are **Stored in the refrigerator**

**Prescribing:**
- 20 units in Glucose 5% to a total volume of 50ml (0.4 units/ml) administered by a Continuous infusion in a syringe via a Central Venous Catheter at a rate of 0.01-0.04 units per min. (1.5ml-6ml /hr)
- Usually initiated at 0.04 units per minute (6ml /hour) and adjusted according to the response. The infusion should be weaned slowly to prevent rebound hypotension when the infusion is stopped.
- Plasma half-life is approximately 10-20mins. The effects wear off around 30-60mins after discontinuation of therapy
- After initiation of a vasopressin infusion noradrenaline requirements should be weaned as appropriate

**Side effects:**
Major adverse effect is ischaemia (including peripheral and GI ischaemia- caused by decreased splanchnic perfusion) due to potent vasopressor effect. Possible bradycardia and arrhythmias however decreased cardiac output are rare at these lower doses.

For a full list of side effects and drug interactions please refer to Summary of product Characteristics (SPC) via www.medicines.org.uk

**References:**
LOCAL AGREEMENT TO PERMIT NURSES TO CHANGE INTRA-ARTERIAL OR INTRA-VENOUS ALTEPLASE (rTPA) INFUSIONS USED IN THE TREATMENT OF CATHETER DIRECTED THROMBOLYSIS.

Clinical Area: Surgical High Dependency Unit (E12)

This document acts as a local agreement and procedure where staff is working outside of the NUH Medicines policy.

1. Reason for local agreement

A local agreement ratified by the Medicines Management Committee is required to enable nursing staff to replace an intra-arterial or intravenous infusion of alteplase (rTPA) that has been previously commenced by a radiologist, as this is an off-label use of the drug.

The aim of this local agreement is to ensure the safe administration of continuous catheter directed infusions of either intra-arterial or intravenous alteplase, and to define the parameters where it may be applied.

2. Background

Eligible patients following radiological intervention for arterial thrombosis or iliofemoral deep vein thrombosis (DVT) may require a continuous catheter directed infusion of alteplase directly into the affected artery or vein. Patients requiring these infusions receive level two care on the surgical high dependency (ward E12, QMC campus).

This agreement recognises that:
- The administration of a continuous catheter directed infusion of alteplase via the intra-arterial or intravenous route is outside its licensed indication for use. The prescriber therefore accepts responsibility for both the prescription and treatment choice. The nurse must administer and monitor the infusion according to the Catheter-Directed Arterial and Venous Thrombolysis manual and this local agreement.
- Intravenous heparin must be run simultaneously with the alteplase on a separate IV cannula and in accordance with the NUH pre-printed prescription and administration record for unfractionated heparin IV infusion.
- The current NMC Standards for Medicines Management 2010 and the current edition of the NUH code of Practice, in particular the Administration of medicines (section CLMM008) must be followed at all times.

3. Objectives of Procedure

The objectives of this procedure are to:
- Ensure the safe administration of continuous catheter directed infusions of either intra-arterial or intravenous alteplase.
- Ensure that only eligible patients, receiving level two care within the surgical high dependency unit (E12, QMC Campus) receive alteplase infusions for this indication.
- Ensure that only nurses with the suitable skills, knowledge and training, working within the surgical high dependency unit administer alteplase infusions in this manner.
4. Eligible Patients/Inclusion Criteria

For patients to be suitable for treatment under this local agreement, all of the following conditions must be satisfied:

- Patients must be inpatients on the surgical high dependency unit (E12).
- Patients must have an intra-arterial or intra-venous catheter with a continuous infusion of alteplase prescribed on the pre-printed prescription.
- This continuous infusion must have been commenced in the radiology department.
- Patients must also have a separate intravenous cannula with an intravenous infusion of heparin prescribed on the NUH pre-printed prescription.

5. Exclusion Criteria

Patients and nurses will be specifically excluded from this local agreement if any of the inclusion criteria defined both above and below are not met.

6. Prescriber Responsibilities and Prescription

The pre-printed prescriptions for both the intra-arterial / intra-venous alteplase and intravenous heparin must be signed and dated by the doctor prior to nursing staff changing any infusions. The infusion must have been commenced in the radiology department, and the prescriber continues to hold responsibility for the prescription where nursing staff work within the parameters of this local agreement. Only prescriptions as described in the table below can be administered in accordance with the local agreement. If the prescriber requires a different dose or rate of infusion this must be prescribed on the Trust drug chart.

IMPORTANT NOTES:

- Ensure the alteplase infusion runs CONTINUOUSLY. Complete re-thrombosis can occur rapidly if the infusion is interrupted.
- Each infusion must be changed every EIGHT hours.
- Heparin is incompatible with alteplase and therefore must run on a SEPARATE intravenous cannula.

Description of treatment available under this protocol & administration details:

<table>
<thead>
<tr>
<th>Drug</th>
<th>Total Amount of Drug</th>
<th>Diluent</th>
<th>Total Volume</th>
<th>Route</th>
<th>Rate (ml / hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alteplase (rTPA)</td>
<td>5mg</td>
<td>Sodium chloride 0.9%</td>
<td>20ml</td>
<td>Insert Route of administration</td>
<td>2 ml / hr</td>
</tr>
</tbody>
</table>
7. **Responsibility of Specialty / Directorate**

The directorate acknowledges that there are health professionals working outside the medicines policy, and acknowledges that this local agreement acts as authority for them to do so.

The specialty is responsible for implementing and monitoring use of this local agreement and for reviewing any incidents which may arise.

8. **Eligible Staff**

For nurses to be eligible to carry out treatment under this local agreement, all of the following conditions must be satisfied:

- Nurses must be registered.
- Nurses must have successfully completed the self-directed learning package and competency document for intravenous drug administration used within critical care.
- Nurses must already be competent to change infusion bags on arterial lines.
- Nurses must have read, understood and be able to practice in accordance with the current “Catheter-directed Arterial and Venous Thrombolysis” manual.

9. **Details of Medicine (include where medicine will be prescribed if applicable)**

<table>
<thead>
<tr>
<th>Medicine</th>
<th>Route</th>
<th>Dose</th>
<th>Frequency / Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alteplase (rTPA)</td>
<td>Intravenous or Intra-arterial- to be inserted by prescriber.</td>
<td>5mg / 20ml 0.9% Sodium Chloride</td>
<td>Continuous Infusion (2ml / hr)</td>
</tr>
</tbody>
</table>

The pre-printed prescriptions for both the intra-arterial / intra-venous alteplase and intravenous heparin must be signed and dated by the doctor prior to nursing staff changing any infusions. Only prescriptions as described in the table above can be administered in accordance with the local agreement. If the prescriber requires a different dose or rate of infusion this must be prescribed on the Trust drug chart.

10. **Documentation**

Pre-printed prescriptions are available at:
- Alteplase- [http://nuhwww/vascular/radiology/lysis.htm](http://nuhwww/vascular/radiology/lysis.htm)
- Heparin – Available in all ward areas- Titled ‘Prescription and administration record for unfractionated heparin intravenous infusion.’ Order code NUH00491S

A copy of the “Catheter-directed Arterial and Venous Thrombolysis” manual is available on the surgical high dependency unit or at:
11. Procedure

Alteplase should be prepared and stored as detailed below:

- Under aseptic conditions dissolve the contents of a 20mg alteplase vial in the 20ml water for injection provided to give a 1milligram per ml solution.
- Take 5 milligrams (5ml) of this solution and make up to a total volume of 20ml with sodium chloride 0.9%.
- Use a 20ml BD plastipak syringe to administer the continuous alteplase infusion.

DOUBLE CHECK:

- That the final volume for infusion is made up to 20ml with sodium chloride 0.9%.
- That the infusions pump is programmed for a 20ml syringe.

The remainder of the alteplase solution in the vial can be labelled with the patient’s name, date and time of preparation. This vial must be stored in the refrigerator. Stability has been demonstrated for 24 hours at 2-8 oC.

Subsequent infusions may be prepared from this vial for up to 16 hours from the time of preparation. The rubber stopper on the alteplase vial must be cleaned prior to each syringe being prepared.

Duration of Therapy

Duration of therapy is determined by the vascular surgeon and the radiologist; this may range from a few hours, up to 72 hours (and is at the discretion of the managing team). Progress is monitored at intervals via angiography.
Local agreement regarding the administration of intravenous drugs within Adult Critical Care

Background

To enable critical care nursing staff to:

- Administer prescribed sedation boluses in the absence of medical staff
- Accept delegated responsibility in a limited range of clinical emergencies

This agreement recognises that the:

- The nurse is responsible for following the local agreement to ensure the safe administration of Intravenous medication in accordance with the current NMC guidelines for the administration of medicines.
- Nottingham University Hospitals NHS Trust will accept responsibility for any consequences /complications that may arise from the administration of IV medication by nursing staff provided the terms of the local agreement have been adhered to.

Patients included

Patients on Adult Intensive Care, (AICU, CCD) Surgical High Dependency (E12) and Medical High Dependency (D56).

Nurses eligible

Registered nurses working within critical care who:

- Have been assessed as being competent in Intravenous therapy following successful completion of the ‘Intravenous Administration of Medications within Adult Critical Care Supplement’
- Are practicing in accordance with the current NUH Medicines Code of Practice.
**Sedation boluses**

**Nurses eligible**

As defined on page 1 of the local agreement. Eligible nurses are authorised to administer bolus doses of analgesia and sedatives from an existing infusion in the absence of medical staff as per table below **PROVIDED** the patient is **NOT SELF-VENTILATING**:

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dose</th>
<th>Route</th>
<th>Administration details</th>
<th>Frequency</th>
<th>Indication</th>
<th>Total dose/number of doses in 24 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alfentanil</td>
<td>1-2mg</td>
<td>C/P</td>
<td>Bolus from existing infusion</td>
<td>8mg per hour</td>
<td>Sedation/Agitation</td>
<td>N/A*</td>
</tr>
<tr>
<td>Morphine</td>
<td>1-5mg</td>
<td>C/P</td>
<td>Bolus from existing infusion</td>
<td>20mg per hour</td>
<td>Sedation/Agitation</td>
<td>N/A*</td>
</tr>
<tr>
<td>Midazolam</td>
<td>2-5mg</td>
<td>C/P</td>
<td>Bolus from existing infusion</td>
<td>20mg per hour</td>
<td>Sedation/Agitation</td>
<td>N/A*</td>
</tr>
<tr>
<td>Propofol</td>
<td>Up to 50mg</td>
<td>C/P</td>
<td>Bolus from existing infusion</td>
<td>200mg per hour</td>
<td>Sedation/Agitation</td>
<td>N/A*</td>
</tr>
</tbody>
</table>

* If the maximum hourly frequency has not achieved the desired sedation score then the baseline infusion rate should be increased to achieve this-inform medical staff.

**Delegated responsibility**

**Sedative drug infusions**

**Circumstance:**
- Either under direct medical supervision, or in an emergency when a prescriber cannot immediately attend a patient in person to prescribe the medication and where reasonable delay might bring harm or prolong suffering to a patient.

A verbal order from the doctor *(by phone or in person)* may be accepted by a critical care nurse and confirmed by a second critical care nurse to prepare and commence one or more of the following infusions as per pre-printed infusion chart: *(see notes on pg 4 on accepting a verbal order by phone)*

<table>
<thead>
<tr>
<th>Drug</th>
<th>Form</th>
<th>Diluent</th>
<th>Route</th>
<th>Admin details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morphine</td>
<td>60mg in 60ml</td>
<td>S</td>
<td>C/P</td>
<td>0-10ml/hr</td>
</tr>
<tr>
<td>Midazolam</td>
<td>50mg in 50ml</td>
<td>Neat</td>
<td>C/P</td>
<td>0-10ml/hr</td>
</tr>
<tr>
<td>Propofol</td>
<td>10mg/ml</td>
<td>Neat</td>
<td>C/P</td>
<td>0-4mg/kg/hr</td>
</tr>
<tr>
<td>Alfentanil</td>
<td>25mg in 50ml</td>
<td>S</td>
<td>C/P</td>
<td>0-10ml/hr</td>
</tr>
</tbody>
</table>

*S* = NaCl 0.9%

The doctor must sign the prescription within **one hour** from the start of the infusions.
Vasopressors, cardiac medication and emergency drugs

Circumstance:

In an emergency, under direct medical supervision only, where the doctor cannot immediately prescribe the medication and where reasonable delay might bring harm or prolong suffering to a patient.

A verbal order from the doctor (in person only) may be accepted by the nurse (s) attending to the patient to prepare and commence:

a) one or more of the following infusions (as per pre-printed infusion chart)

<table>
<thead>
<tr>
<th>Drug</th>
<th>Form</th>
<th>Diluent</th>
<th>Route</th>
<th>Admin details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noradrenaline (Norepinephrine)</td>
<td>20mg in 250ml</td>
<td>G</td>
<td>C</td>
<td>0 - 1microgram/kg/min</td>
</tr>
<tr>
<td>Adrenaline (Epinephrine)</td>
<td>20mg in 250ml</td>
<td>G</td>
<td>C</td>
<td>0 - 1microgram/kg/min</td>
</tr>
<tr>
<td>Dobutamine</td>
<td>500mg in 100ml</td>
<td>G</td>
<td>C</td>
<td>0 – 20 microgram/kg/min</td>
</tr>
<tr>
<td>Amiodarone Load</td>
<td>300mg in 25ml</td>
<td>G</td>
<td>C</td>
<td>Infuse over 30 mins</td>
</tr>
</tbody>
</table>

b) a stat dose of the following emergency drugs

<table>
<thead>
<tr>
<th>Drug</th>
<th>Form</th>
<th>Diluent</th>
<th>Route</th>
<th>Admin details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geloplasma</td>
<td>500ml</td>
<td>N/A</td>
<td>C / P</td>
<td>As a fluid bolus</td>
</tr>
<tr>
<td>Diazepam</td>
<td>10mg</td>
<td>N/A</td>
<td>C / P</td>
<td>IV bolus over 2-3mins</td>
</tr>
<tr>
<td>Lorazepam</td>
<td>1-4mg</td>
<td>N/A</td>
<td>C / P</td>
<td>Do not exceed a rate of 2mg in 1 minute.</td>
</tr>
<tr>
<td>Plasmalyte</td>
<td>250-500ml</td>
<td>N/A</td>
<td>C / P</td>
<td>As a fluid bolus</td>
</tr>
</tbody>
</table>

The prescription must be signed by the doctor who gave the verbal order as soon as is reasonably possible.

- **During the following procedures**: Bronchoscopy, Intubation or Chest drain insertion under direct medical supervision, the doctor undertaking the procedure may give a verbal order to the patients nurse to administer the one or more of the following drugs:

<table>
<thead>
<tr>
<th>Drug</th>
<th>Drug</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adrenaline</td>
<td>Fentanyl</td>
</tr>
<tr>
<td>Suxamethonium</td>
<td>Ephedrine</td>
</tr>
<tr>
<td>Propofol</td>
<td>Atracurium</td>
</tr>
<tr>
<td></td>
<td>Alfentanil</td>
</tr>
<tr>
<td></td>
<td>Midazolam</td>
</tr>
</tbody>
</table>

Immediately on completion of the procedure the drugs and doses administered must be prescribed on the Stat section of the drug chart by the doctor and the administration signed by the nurse.
Definitions

Direct medical supervision- a member of medical staff in attendance AT THE BEDSIDE.

Verbal Orders
The current NUH Medicines Code of practice does not authorise practitioners to accept verbal orders except under exceptional circumstances where a delay may cause harm or suffering to a patient. It also states that a Controlled Drug must never be administered as a verbal order. This local agreement authorises a practitioner to accept a verbal order for the administration of a new drug, including controlled drugs in the following exceptional circumstances only:

- a clinical emergency when a prescriber cannot immediately attend a patient in person to prescribe and where reasonable delay might bring harm or prolong suffering to a patient
- where initiation of life saving drug therapy is required

All verbal orders must include the approved drug name, dose, route and rate of administration.

Accepting a verbal order by phone

- The verbal order should be taken by the bedside nurse or nurse in charge.

- The prescriber must:
  - confirm the identity of the patient;
  - state the name of the medicine to be administered;
  - state the dose to be administered;
  - state the route and time to be administered.

- A second nurse should then witness the verbal order, confirming the details with the prescriber and that the details are as per pre-printed Critical Care IV standard infusion chart.

- The prescribers name giving the verbal order must be printed on the IV infusion chart and must be signed within one hour by the prescriber who gave the verbal order.

- A record providing the doctors name, details and the reasons for the verbal order should be documented in the nursing notes and signed by the two nurses that accepted the verbal order.

Last updated by Ele Mills, Checked by Elizabeth Jamieson, 2016

Document approved for use by:

<table>
<thead>
<tr>
<th>Title</th>
<th>Name</th>
<th>Signature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head of Service Critical Care</td>
<td>Tony O’Leary</td>
<td></td>
</tr>
<tr>
<td>Matron Critical Care</td>
<td>Rebecca Selwyn</td>
<td></td>
</tr>
<tr>
<td>Advanced Practitioner Critical Care</td>
<td>Elizabeth Jamieson</td>
<td></td>
</tr>
<tr>
<td>Critical Care Pharmacist</td>
<td>Eleanor Mills</td>
<td></td>
</tr>
<tr>
<td>Chair of Medicines Management Committee</td>
<td>Mohamed Rahman</td>
<td></td>
</tr>
</tbody>
</table>
Local Agreement for Adult Critical Care Nursing Staff to Administer Intravenous Haloperidol

Background

Adult critical care inpatients at Nottingham University Hospitals may require treatment with haloperidol. Currently in the United Kingdom haloperidol only holds a licence to be administered orally and intramuscularly (IM), therefore its use intravenously is unlicensed. The intravenous route of haloperidol administration in many critical care patients maybe favoured due to previously obtained intravenous access and the rapid onset of pharmacological action. It is also recognised that in acutely agitated patients the intramuscular route carries a potentially higher risk of needle stick injuries.

The aim of this local agreement is to ensure the safe and continued administration of intravenous haloperidol by nursing staff in adult critical care ward areas. The NUH medicines policy does not currently address the administration of licenced products via an unlicenced route, and whether a nurse is permitted to administer via an unlicenced route. Administration of intravenous haloperidol can be hazardous and therefore a local agreement ratified by the Medicines Management Committee is required for critical care nursing staff to continue practice in administering haloperidol via the unlicensed intravenous route.

This local agreement recognises that:

- The administration of intravenous haloperidol is outside its licenced method of administration. The prescriber therefore accepts responsibility for both the prescription and treatment choice.

- The current NMC Standards for Medicines Management 2010 and the current edition of the NUH code of Practice, in particular the Administration of medicines (section CLMM008), must be followed at all times.

Patient Group Included

- Patients who have been admitted to: Adult critical care (Wards E12, D56, AICU QMC campus, CC 1-17 City campus) Adult Cardiac Critical Care or the Level 1 trauma ward. (C30)

- Patients who have been prescribed intravenous doses of haloperidol on the trust drug chart.

Health professionals authorised to administer drugs under this local agreement

Registered nurses working in critical care wards listed above who have successfully completed the intravenous drug administration competency package within NUH

Administration of Intravenous Haloperidol

Haloperidol is a ‘typical’ antipsychotic included in the guidelines for the detection and management of delirium in adult critical care. Intravenous administration of haloperidol carries a higher risk of QT prolongation compared to the IM, oral and nasogastric routes. The usual total daily dose of intravenous haloperidol is 5-20mg daily in divided doses (e.g. between 1mg - 5mg IV 6 hourly). If additional doses are required, ‘as required’ doses of
between 1mg-2.5mg PRN may be administered, up to a maximum total daily dose of 30mg including all regular doses'.

ECG monitoring should be conducted during all intravenous doses of haloperidol to monitor for QT prolongation and serious cardiac dysrhythmias.

Discontinuing therapy

Intravenous haloperidol administration MUST be discontinued if QT prolongation occurs to the order of QTc>450msec or 25% greater than previous ECG readings. Medical advice should be sought immediately.

How to administer intravenous Haloperidol

<table>
<thead>
<tr>
<th>Direct Injection</th>
<th>Diluent</th>
<th>Method of administration using a side arm of giving set or into indwelling cannula / CVC without further dilution</th>
</tr>
</thead>
<tbody>
<tr>
<td>For single doses up to 5mg nurse administration</td>
<td>Already in solution 5mg in 1ml</td>
<td>Inject over 1-2 minutes May further dilute with sodium chloride 0.9% to aid administration</td>
</tr>
<tr>
<td>For single doses &gt; 5mg see below</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

A doctor must be in attendance for any single dose given over 5mg. The maximum total daily dose is 30mg. This may be rarely exceeded at the discretion of a senior medical registrar or consultant. A doctor must be in attendance for administration of any doses exceeding 30mg a day*.

Prior to transfer from critical care areas

A review of regular/as required haloperidol prescriptions must be undertaken. If continued the route of administration must be changed to oral or IM. For any regular haloperidol prescriptions a treatment plan including discontinuation must be documented by medical staff in the medical records.

Supporting documents

NMC Standards for Medicines Management April 2010
Nottingham University Hospitals NHS Trust Code of Practice (Current Edition)
Nottingham University Hospitals Guidelines for the detection of and Management of Delirium in Adult Critical Care Nov 2012.
*UKCPA Delirium guidelines 2006
LOCAL AGREEMENT FOR NURSING STAFF TO CHANGE RATES OF UNFRACTIONATED HEPARIN ADMINISTERED BY CONTINUOUS INTRAVENOUS INFUSION

Clinical Area: Adult Critical Care; Renal, Admission and Cardiology Ward Areas

This document aims to act as a local agreement and procedure where staff is working outside the NUH Medicines policy.

1. **Reason for Local Agreement**

A local agreement ratified by the Medicines Management Committee is required, as nursing staff will alter rates of the heparin infusion, within defined parameters, after checking APTT results without the need to contact the prescriber - provided an APTT ratio of 1.5 to 2.5 is the desired range.

2. **Background**

Inpatients at Nottingham University Hospitals may require a continuous intravenous unfractionated heparin infusion for a number of clinical indications. The aim of this local agreement is to ensure the safe continued administration and monitoring of unfractionated heparin infusions by nursing staff in specified ward areas and to facilitate safe, timely and effective care.

This local agreement recognises that:

- The prescriber is responsible for the unfractionated heparin prescription.
- The nurse is responsible for following the instructions on the NUH pre-printed unfractionated heparin infusion chart for adjustment of the Heparin dosage according to APTT ratio and the subsequent monitoring required.
- **In all cases where the APTT is > 7 in addition to stopping the infusion the prescriber must be informed.**
- The current NMC Standards for Medicines Management 2010 and the current edition of the NUH code of Practice, in particular the Administration of medicines (section CLMM008) must be followed at all times.

3. **Objectives of Procedure**

The objectives of this procedure are to:

- Ensure the safe administration of continuous intravenous unfractionated heparin infusions.
- Ensure that only eligible patients, receiving care upon appropriate, specified wards receive treatment via this local agreement.
- Ensure that only nurses whom have successfully completed the NUH intravenous drug administration competency package and any other local induction training and competency packages follow the local agreement.

4. **Eligible Patients/ Inclusion Criteria**

Patients who have been admitted to:

- **Adult Critical Care Areas**
  - QMC Campus: Wards E12, D56, AI CU, or the Level 1 Trauma Ward (C30)
  - City Campus: CCD 1-17
- **Renal Wards**
  - Bramley and Carrel
- **Admission Units**
  - Wards B3, D57 (including level1) and SRU (City Campus)
- **Cardiology Wards**
  - QMC Campus: Wards D55 (CCU),
City Campus: Acute Cardiac Unit, Cardiac Intensive Care / High Dependency Unit, Morris and Papplewick

Patients who have been prescribed an unfractionated heparin intravenous infusion on the trust pre-printed drug chart.

5. Exclusion Criteria

- Patients where the prescriber has set the desired APTT ratio higher or lower than 1.5 -2.5. In these cases a doctor must make the required alterations on the prescription to the change in rate of infusion.

6. Responsibility of Specialty / Directorate

The directorate acknowledges that there are health professionals working outside the medicines policy, and acknowledges that this local agreement acts as authority for them to do so.

The specialty is responsible for implementing and monitoring use of this local agreement and for reviewing any incidents which may arise.

7. Eligible Staff

Registered Nurses who have successfully completed the Intravenous drug administration competency package within NUH.

8. Details of medicine (include where medicine will be prescribed if applicable)

<table>
<thead>
<tr>
<th>Medicine</th>
<th>Route</th>
<th>Dose</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unfractionated Heparin</td>
<td>Intravenous</td>
<td>According to APTT</td>
<td>Continuous Infusion</td>
</tr>
<tr>
<td>(1000 units / ml)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

9. Documentation

The following are supportive documents relating to this local agreement:

- NMC Standards for Medicines Management April 2010
- Nottingham University Hospitals NHS Trust Code of Practice (Current Edition)
- Nottingham University Hospitals NHS Trust Guide to Intravenous Therapy (Current edition)
- Nottingham University Hospitals Prescription and administration record for unfractionated heparin intravenous infusion. MMC 02/09

10. Procedure

A prescription and administration record for unfractionated heparin by intravenous infusion has been designed for use within NUH and incorporates guidance on adjusting infusion rates of heparin according to APTT results.

The Nottingham University Hospitals NHS Trust Guide to Intravenous Therapy allows nursing staff to administer the prescribed loading dose of heparin. This is followed by a prescribed continuous infusion of heparin 1000units/ml administered via a syringe pump.

The APTT should be monitored in accordance with the guidance on the prescription chart or as per the written instructions from the prescriber.

All changes to the rate of infusion as a result of an APTT ratio outside the desired range must be second checked by an eligible practitioner (as per the code of practice). Both the heparin prescription chart and within critical care the 24 hour observations chart must be signed by both practitioners.

Signed version available at: http://nuhnet/medical_director/committees/medicines_management_committee/Pages/Copiesoflocalagreementsapproved.asp